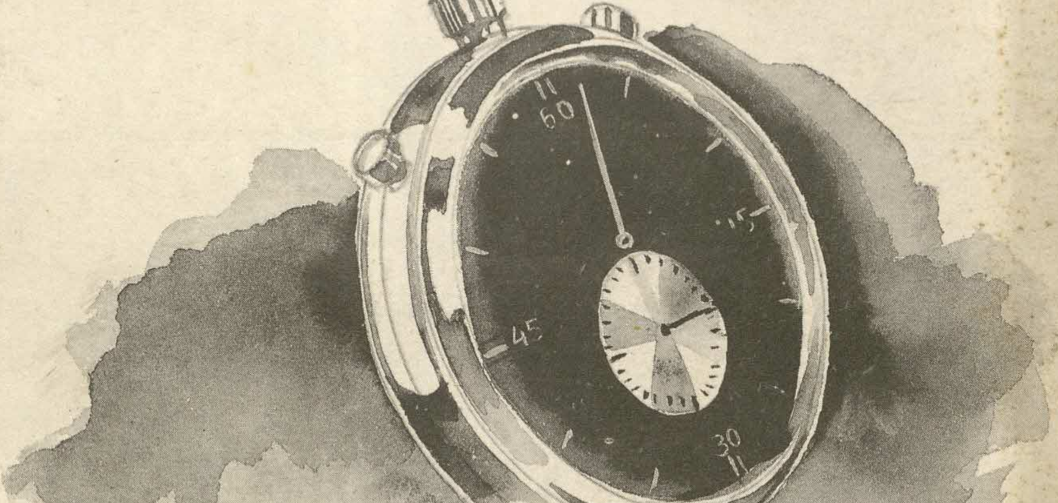
NEW MATRICULATION PHYSICS



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NEW MATRICULATION PHYSICS 7

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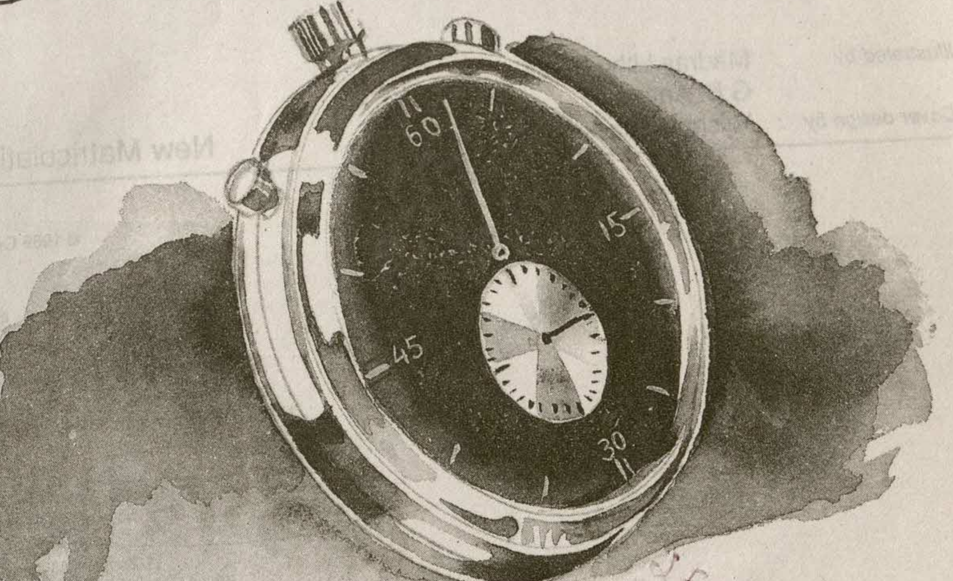

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To the teacher

New Matriculation Physics is a series of five books developed for class 6-10 of the Tamil Nadu Matriculation system. It closely follows the new enriched Matriculation syllabus.

One of the main features of the new syllabus is that activity and observation are given a very important place in understanding science. Every effort has been made to unfold the scope and purpose of the syllabus. This series departs from the conventional and emphasises a practical, 'discovery' and 'learning by doing' approach.

The subject matter to be studied has been carefully arranged keeping in mind the age level and psychology of the child. No effort has been spared to support the text with clear, labelled illustrations. The language has been kept simple and direct to enable the students to read the text themselves.

Several activities and projects have been suggested, wherever possible, within the scope of the lesson. Most of these need simple improvising or inexpensive materials.

The exercises for each chapter are exhaustive and include questions based on comprehension and application of basic principles rather than on mere recall.

It has been the concern of the authors that children are encouraged to discover for themselves the pleasure of learning about the fascinating 'laws of nature'.

The author

MATRICULATION SYLLABUS FOR STANDARD VII - PHYSICS

S.No.	*Concept/Theme*	*Expected outcome of learning*	*Teaching/Learning activities*
1.	**Measurement**		
1.1	Regular and irregular areas	Uses graph paper to take measurements.	Measures surface area of regular and irregular shapes using graph paper.
1.2	Volumes of regular and irregular solids and volumes of liquids	Uses measuring vessels (litre cans, overflow cans and droppers).	Measures the volume of given solids by displacement. Finds small volumes (like volume of a ball bearing, or drop of liquid).
13.	Mass and weight and their units	Differentiates between mass and weight.	Learns to use a spring balance, a physical or a commercial balance like a vegetable vendor's scales.
1.4	Time	Recognises various timing devices - stop watch, clock, pendulum, etc.	Experiments with pendulums of different lengths, and with different bobs and amplitudes.
2	**Mechanics**		
2.1	Simple machines	Recognises the type of machine and the principle involved. Appreciates the advantage of each type, as also the limitations.	Models of screw, wedge, wheel and axle, and pulley. Finds the force required to pull up loads along an inclined plane at different angles. Lists example of simple machines used at home and recognises the principle involved. Does experiments involving pulleys.
2.2	Machines and energy	Recognises the need to put in energy/work to get output.	Lists out the different forms of energy, and different sources of energy used to do work.
2.3	Transformation of energy	Recognises the changes in the form of energy.	Finds examples from daily life using energy transformation.
2.4	Machine maintenance and care - friction, methods of reducing friction	Recalls way of minimum effort of friction machines. Recalls uses of friction in daily life.	Lists ways of improving efficiency of machines such as lubrication, streamlining and use of ball bearings. Uses of friction in daily life observing treads on tyres, etc. Makes models of ball bearings. Finds the c.g. of regular/irregular bodies.
2.5	Centre of gravity	Locates centre of gravity in bodies sees relationship between stability and centre of gravity of a body.	Identifies objects where the c.g. lies outside the body. Recognises the conditions for stability in objects found around.
3	**Hydrostatics**		
3.1	Regions of the atmosphere	Recognises regions of the atmosphere.	Does simple experiments like crushing can, model of Madgeburg hemispheres.

S.No.	Concept/Theme	Expected outcome of learning	Teaching/Learning activities
3.2	Air pressure		
3.3	Barometer	Measures air pressure.	Constructs a simple barometer. Examines an aneroid barometer or altimeter, and understands its use in measuring air pressure, altitude or for forecasting weather.
3.4	Applications of fluid pressure	Understands the functioning of commonly used devices working on this principle.	Makes models of siphon or flush tank. Studies the actual working of a hand or motor-driven water pump.
4	**Heat**		
4.1	Thermal expansion	Compares changes due to thermal expansion.	Experiments to show that different solids expand differently for the same temperature rise. Does similar experiments to show liquids expand differently too.
4.2	Liquid thermometers	Recognises the uses of thermal expansion.	Learns use of thermometers - clinical, lab and maxmimum and minimum. Compares thermometric liquids.
4.3	Vaporisation	Distinguishes between evaporation and boiling.	Experiments to study the factors which affect boiling and evaporation. Observes the effect of pressure on boiling point of water-working of a pressure cooker.
4.4	Transfer of heat Conduction Convection Radiation	Recognises good conductors and insulators. Distinguishes between conduction and convection. Gives reasons for differences in the three modes.	Compares different conductors. Lists commonly used insulators poor conductivity of water. Conductivity of copper gauze used to advantage as in the Davy Safety Lamp. Sets up convection currents in water. Makes model of ventilating systems. Does experiments to establish factors increasing radiation.
4.5	Thermos flask	Appreciates the means used to minimise heat loss.	Opens out and examines the construction of a flask.
4.6	Solar heat	Realises the need to harness solar power.	Observes solar collectors, solar panel, cooker or cell.
5	**Light**		
5.1	Light travels in straight lines	Distinguishes between ray and beam.	Constructs a pinhole camera.
5.2	Eclipses	Infers the causes of shadow formation.	Makes a model of a sundial to appreciate early use of shadow. Demonstrates eclipse formation using models.
5.3	Reflection	Recognises that not only mirrors but all smooth surfaces reflect light.	Lists common reflections other than mirrors, around the house and outside. Compares regular and diffused reflection. Studies the characteristics of image formed in plane mirrors.

S.No.	*Concept/Theme*	*Expected outcome of learning*	*Teaching/Learning activities*
5.4	Curved mirrors	Analyses the process of reflection in different types of mirrors.	Makes a simple comparison of images in convex and concave mirrors.
5.5	Refraction	Differentiates between reflection and refraction. Gives reasons for refraction taking place.	Observes things as seen through various transparent media like water, glass, etc. Refraction in nature—the rainbow. Making an artificial rainbow with water hose.
6	**Sound**		
6.1	Propagation of sound through solids, liquids and gases	Demonstrates by devising simple experiments to observe how sound travels through solids, liquids and air.	
6.2	Wave motion	Recognises vibration is the cause of sound, and its propagation as waves (on an analogy with water waves).	
6.3	Conduction	Infers the necessity of material medium for sound transmission.	
6.4	Hearing and speaking	Analyses the functioning of the voice box and eardrum.	Makes of the voice box and eardrum - to demonstrate how they function.
6.5	Difference in sounds	Distinguishes sounds, on the basis of pitch, loudness and tone.	Experiments to see what factors affect pitch, loudness and tone. Constructs simple musical instruments using bottles, cups, metal strips, etc.
7	**Magnetism**		
7.1	Properties of magnet	Recognises the properties of magnets.	Experiments to observe the different properties of a magnet.
7.2	Making magnets	Makes magnets, adopting different processes.	Making a magnet using the single and double touch methods, and electric methods. Observes the difference between temporary and permanent magnets.
7.3	Care of magnets	Gives reason for demagnetisation.	Lists ways of taking proper care of magnets. Finds out how magnets get demagnetised.
7.4	Uses	Recognises the use of magnets in commonly used appliances at home and school.	Lists devices using magnets. Attempts to observe their function in the device.
8	**Electricity**		
8.1	Sources	Identifies different sources of electricity.	Lists appliances where electricity is used and identifies the source of current in each case.
8.2	Cells and generators	Distinguishes between dry, wet and solar cells.	Understands the use of each. Makes a field trip to see a power generator or a battery making division.
8.3	Magnetic effect of current	Recognises various uses of electromagnets.	Makes models of electric bell, telegraph and telephone systems, to understand the use of electro magnets in their functioning.

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1. Measurement

Regular and irregular areas - volumes of regular and irregular solids and volumes of liquids - measuring vessels - mass and weight and their units - time - timing devices.

1.1 Regular and irregular areas

Almost all measurements in physics are related to the three chosen fundamental units of length, mass and time. In 1960 it was decided at the general conference of weights and measures that all countries would use a system of units called the International system (SI) of units. In this system, the fundamental units of length, mass and time are the metre, kilogramm and second respectively (MKS).

MEASUREMENT OF AREA

The extent of the surface of a body is called its area.

The unit of area is the unit of length ^{2} and is expressed as metre ^{2} or m^2. If the area to be measured is much smaller than 1 m^2, we measure it in terms of square centimetre (Fig.1.1) or square millimetre.

Thus

$$1\ m^2 = (100\ cm)^2$$
$$= 10{,}000\ cm^2$$
$$\text{and } 1\ m^2 = (1000\ mm)^2$$
$$= 100{,}00{,}00\ mm^2$$

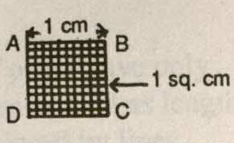


Fig. 1.1 A square centimetre

MEASUREMENT OF AREA OF REGULAR FIGURES

When it is stated that the area of a figure is 4 square centimetres, it does not necessarily mean that the figure must be a square with each of its sides 2 centimetres long. It means that the figure contains as much surface as a square with each of its sides 2 centimetres long. In Fig 1.2, the five figures are all of different shapes, but are equal in area. They are called regular figures because the area of each can be calculated by making use of a certain rule. You have already learnt the rules/formula for calculating the areas of regular figures.

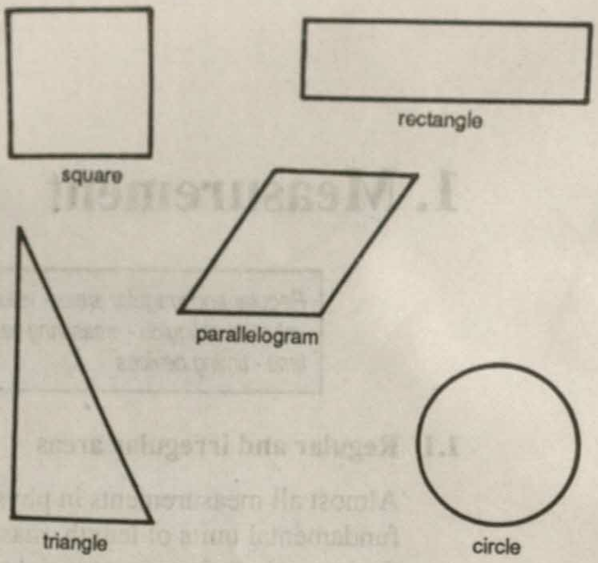
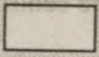
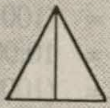
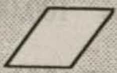


Fig. 1.2 The area of each figure is 4 square centimetres

Activity 1 : *Match the shapes given in A with the areas in B in the table given below.*

A

No.	*Shape*	*Figure*
1.	Square	
2.	Rectangle	
3.	Triangle	
4.	Parallelogram	
5.	Circle	

B

Area	*Formula sq.m. or m^2*
l x b	lb
base x perpendicular height	bh
π x (radius)^2 where $\pi = 22/7$	πr^2
l x l	l^2
1/2 base x height 1/2 x b x h	1/2 bh

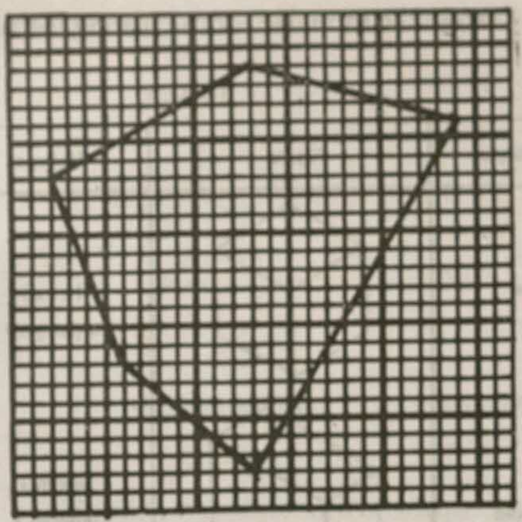
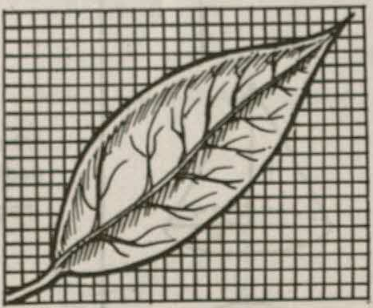


Fig. 1.3 The area of an irregular figure

MEASUREMENT OF AREA OF IRREGULAR FIGURES

Fig. 1.3 illustrates a method of finding the area of an irregular figure. The figure is drawn on a graph paper. The area is obtained by counting the number of square millimetres enclosed within the boundary of the figure. When counting the fractions of a square, ignore a fraction if more than half of the area of a square lies outside the boundary. But, if half or more than half of the area of a square lies inside the boundary, count the fraction as a whole square. To obtain the area of the irregular figure in square centimetres, divide the number of squares counted by 100.



Activity 2 :*Draw the outline of a leaf on a sheet of graph paper and find its area.*

Activity 3 :*Draw the outline of a rectangle on a graph paper and find its area by counting the squares. Verify your result by calculating the area from its length and breadth.*

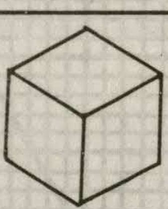
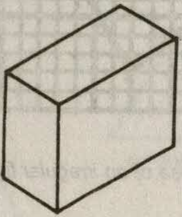
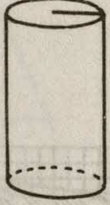
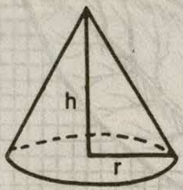
1.2 Volumes of regular and irregular solids and volumes of liquids

VOLUMES

Plane figures, that is, those represented on a sheet of paper have only two dimensions. When a figure has depth or thickness as well as length and breadth, it is called a solid. A plane figure is enclosed by lines while a solid figure is enclosed by surfaces and occupies an amount of space called its volume. The unit of volume is also derived from the unit of length and is the cubic cm (c.c) i.e., the volume of a cube with each edge 1 cm. The SI unit of volume is a cubic metre or m^3.

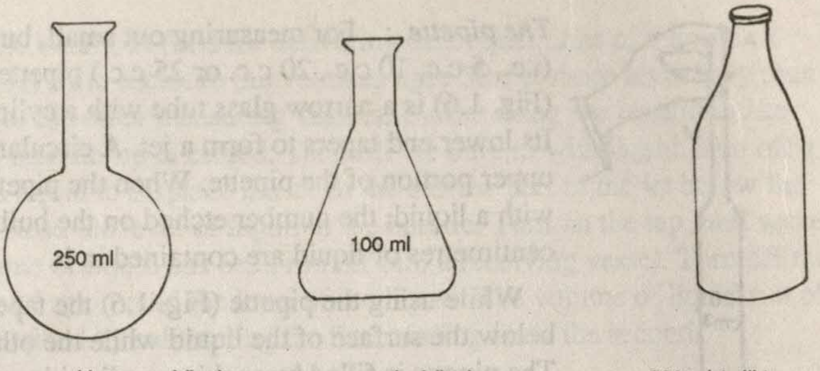
Table 1 shows the formulae for calculating the volume of regular bodies.

TABLE 1

No.	Shape	Figure	Volume	Cublic metres or m^3
1.	Cube		l x l x l = $(\text{length})^3$	l^3
2.	Cuboid		length x breadth x height = l x b x h	lbh
3.	Cylinder		π x $(\text{radius})^2$ x height	πr^2h
4.	Solid Cone		1/3 x π x $(\text{radius})^2$ height	1/3 πr^2h
5.	Sphere		4/3 x π x $(\text{radius})^3$	4/3 πr^3

VESSELS USED IN MEASURING THE VOLUME OF A LIQUID

A quantity of liquid has a definite volume but no definite shape of its own and takes up the shape of the vessel into which it is poured. A number of glass vessels known as measuring flasks are used in measuring large, definite volumes of a liquid. These flasks are of sizes 50 c.c., 100 c.c., 250 c.c., 500 c.c., and 1000 c.c. (a litre).



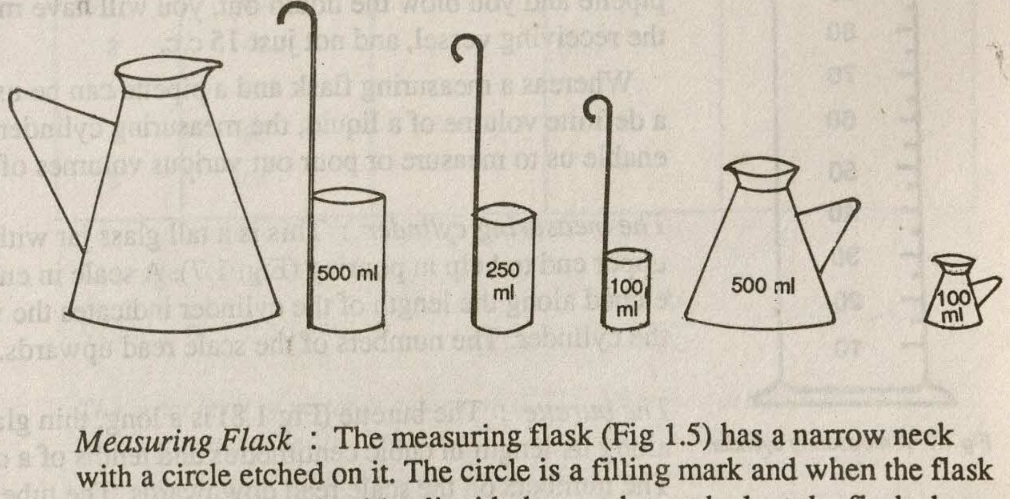
round bottomed flask *conical flask* *500 ml (milk)*

Fig 1.4

The litre is defined as the volume occupied by 1 kg of water. One thousandth of a litre is called a millilitre or a cubic centimetre i.e., 1 litre = 1000 ml = 1000 c.c. A milk bottle holds 500 ml or 1/2 litre of milk.

Activity 4 : *Observe the different types of vessels used to measure*
1. milk by local vendors.
2. mobile oil or petrol at a petrol bunk. Find out the capacity of these.

Activity 5 : *Say where you have seen the following measures for volume being used. See whether you can use them for measuring liquids.*



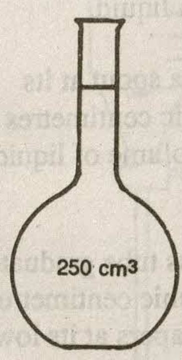


Fig. 1.5 A measuring flask

Measuring Flask : The measuring flask (Fig 1.5) has a narrow neck with a circle etched on it. The circle is a filling mark and when the flask is filled to this mark with a liquid, the number etched on the flask shows how many cubic centimetres of liquid are contained in it.

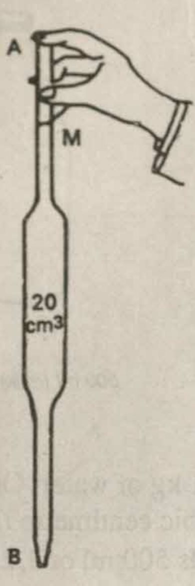


Fig 1.6 A pipette

The pipette : For measuring out small, but definite volumes of liquid (i.e., 5 c.c, 10 c.c., 20 c.c. or 25 c.c.) pipettes are used. A pipette, (Fig. 1.6) is a narrow glass tube with a cylindrical bulb in the middle. Its lower end tapers to form a jet. A circular mark is etched on the upper portion of the pipette. When the pipette is filled upto this mark with a liquid, the number etched on the bulb shows how many cubic centimetres of liquid are contained in it.

While using the pipette (Fig. 1.6) the tapering end *B* is dipped well below the surface of the liquid while the other end *A* is put in the mouth. The pipette is filled by sucking up liquid to about a couple of centimetres above the filling mark, *M*, and then quickly closing the upper end *A* with a finger as it is removed from the mouth. By cautiously raising the finger, the outflow of liquid from the pipette may be controlled until the level of liquid is gradually lowered to the filling mark. On completely removing the finger from the upper end, the volume of liquid as indicated by the number on the bulb of the pipette will be delivered into a receiving vessel.

Two precautions must be observed when using a pipette. Firstly, when sucking up liquid into the pipette, great care must be taken to avoid sucking any of the liquid into the mouth. Secondly, the liquid should be allowed to run out and must not be blown out. This second precaution is necessary because there is always a drop left in tip *B* of the pipette after a liquid has been allowed to run out. A pipette is made to deliver the volume stated on its bulb without getting out the last drop or two left in the tip. If, for example, you are using a 15 c.c. pipette and you blow the liquid out, you will have more than 15 c.c. in the receiving vessel, and not just 15 c.c.

Whereas a measuring flask and a pipette can be used to measure out a definite volume of a liquid, the measuring cylinder and the burette enable us to measure or pour out various volumes of a liquid.

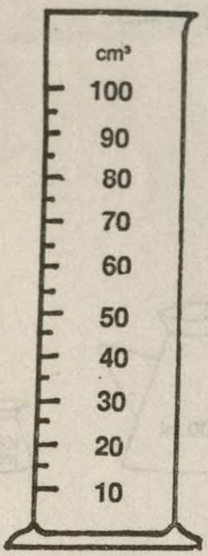


Fig 1.7 A measuring cylinder

The measuring cylinder : This is a tall glass jar with a spout at its upper end to help in pouring (Fig. 1.7). A scale in cubic centimetres etched along the length of the cylinder indicates the volume of liquid in the cylinder. The numbers of the scale read upwards.

The burette : The burette (Fig 1.8) is a long, thin glass tube graduated along its length in cubic centimetres and tenths of a cubic centimetre. The numbers on the scale read downwards. The tube tapers at its lower end where a glass tap, or rubber tubing and clip are provided to regulate the quantity of liquid flowing out from the burette.

The burette is used for delivering exact quantities of a liquid. It enables us to measure out volumes upto 50 c.c. more accurately than any of the other measuring vessels. Before using the burette, make sure that the tap is closed. Then fill the burette with liquid. Run off a little liquid to displace the air in the narrow part of the jet below the tap. Read the level of liquid in the burette. Turn on the tap until some volume of liquid has been run off into a receiving vessel. Turn off the tap and again read the level of the liquid. The volume of liquid run off is obtained by subtracting the first reading from the second.

The burette can also be used to determine the volume of solids available in the form of small bits such as glass beads or lead shots.

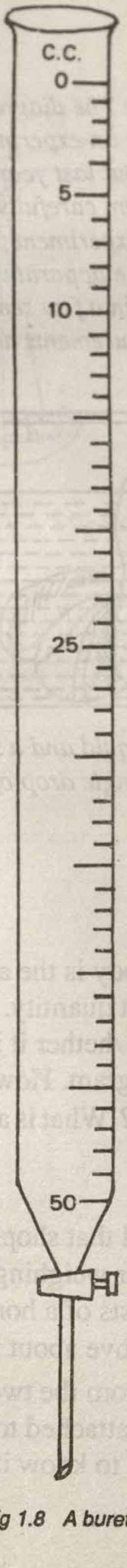


Fig 1.8 A burette

Activity 6 : *Find the volume of a lead shot using a burette.*

Things needed : a burette, stand, water, some lead shots.

Method : The burette is first cleaned and then clamped in a vertical position with the help of a stand. Water is then poured in upto a certain level in the burette, and the exact volume is read without parallax error. A fixed number of lead shots (say 20) are then taken and dropped gently one by one into the burette, so that no water splashes out. Any air bubbles formed can be driven out by gently tapping the burette.

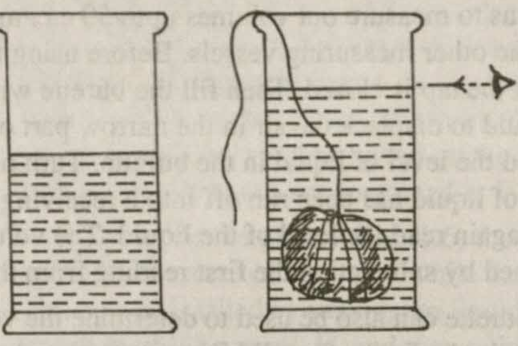
Serial No.	No. of lead shots	Initial level	Final level	Difference = volume of 20 lead shots
1	20			
2	40			
3	60			
4	80			
5	100			

Average volume $V =$

Volume of 1 lead shot $= \dfrac{V}{20\text{ c.c}} = \dfrac{V}{20} \times 10^{-6}\ \text{m}^3.$

The exact level of water is again noted. The difference between the two levels of water gives the volume of 20 lead shots. In this manner every time 20 lead shots are dropped, the volume is read off and tabulated. The average volume of 20 lead shots is calculated and the volume of 1 lead shot found.

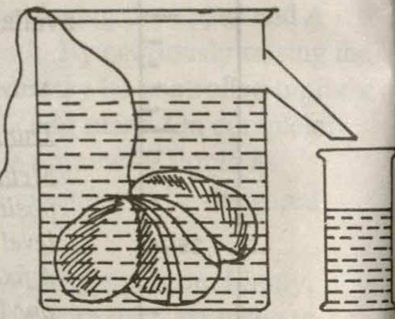
VOLUME OF IRREGULAR SOLIDS



Activity 7 : *The diagram given here is for an experiment you learnt about last year. Study the diagram carefully. What does the experiment prove? What is the apparatus called? Describe in a few sentences how measurements are made with it.*

Activity 8 : *This is the diagram of a certain experiment.*

What is the apparatus called ? What is the experiment for ? Describe how and what measurement are made with it.



Activity 9 : *If you were given an ink dropper, some liquid and a small measuring jar, how would you find the volume of a single drop of liquid.*

1.3. Mass; weight and their units

Mass : All bodies possess mass. The mass of a body is the amount of matter it contains. The mass of a body is a constant quantity. A cubic metre of iron contains the same amount of matter whether it is on the earth or on the moon. The SI unit of mass is a kilogram. How many grams are there in a kilogram ? What is a milligram? What is a centigram

MEASUREMENT OF MASS

The commercial balance : You might have noticed that shopkeepers and vegetable vendors use some kind of balance for weighing. This balance is called a commercial balance. This consists of a horizontal beam. It is supported at its centre and can freely move about its support.

Two scale pans of equal weight are suspended from the two ends of a beam and equidistant from the centre. A pointer is attached to the centre of the beam. The movement of the pointer helps us to know if the masses in the pans are equal.

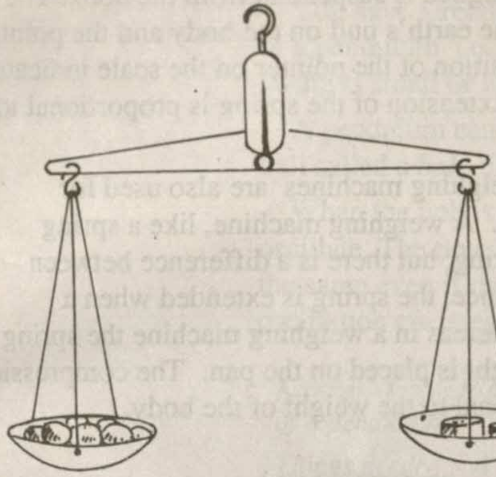


Fig 1.9 A commercial balance

When the pans are empty the pointer should come to rest at the centre, i.e., it should be vertical. The object to be weighed is placed in the left pan and weights are placed on the right pan till the pointer is again vertical. The weights in the right pan are then equal to the weight of the object.

Activity 10 : *Find out if there is a commercial balance in your school or home. Weigh objects using the 1 kg, 500 gm, 200 gm, 100 gm, and 50 gm weights.*

Potatoes = ... *kg.*

Onions = ... *kg.*

Ginger = ... *gm.*

Chillies = ... *gm .*

When we use the common balance we are really comparing masses of objects placed in the left pan to known weights in the right pan.

MEASUREMENT OF WEIGHT

The weight of a body is the force with which the earth attracts a body. This force is called the force of gravity. The weight of a body is not constant. A body weighs more at the poles and less at the equator. The weight of a body depends on its mass.

Weight is a force and so it is measured in units of force which is the Newton (N). Weight is measured using a spring balance.

The spring balance : A spring balance (Fig 1.10) consists of a spring with a hook attached to the lower end from which a weight can be suspended. A pointer is attached to the spring which moves over a graduated scale on

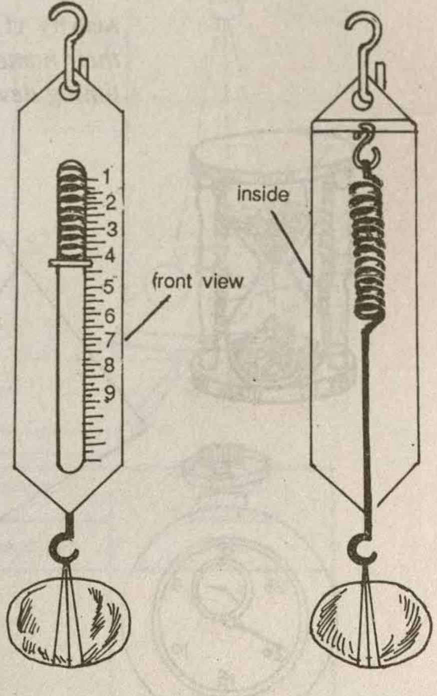


Fig. 1.10 Spring balance

the casing. The body to be weighed is suspended from the hook. The spring gets stretched due to the earth's pull on the body and the pointer moves over the scale. The position of the pointer on the scale indicates the weight of the body. The extension of the spring is proportional to the weight of the body.

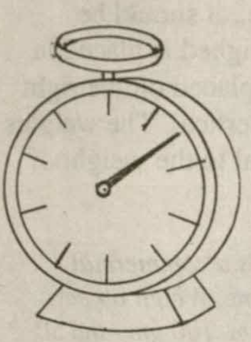


Fig. 1.11 A weighing machine

Weighing machines : Weighing machines are also used for measuring weight (1.11). A weighing machine, like a spring balance, consists of a spring, but there is a difference between the two. In a spring balance, the spring is extended when a weight is suspended, whereas in a weighing machine the spring is compressed when a weight is placed on the pan. The compression of the spring is proportional to the weight of the body.

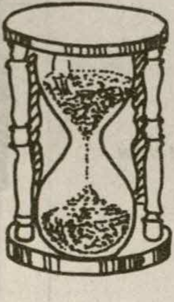
1.4 Time

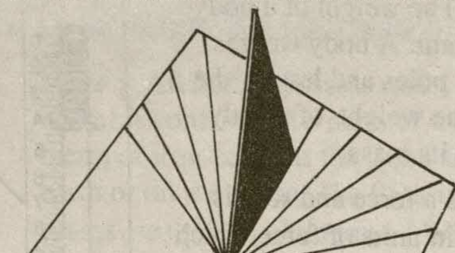
MEASUREMENT OF TIME

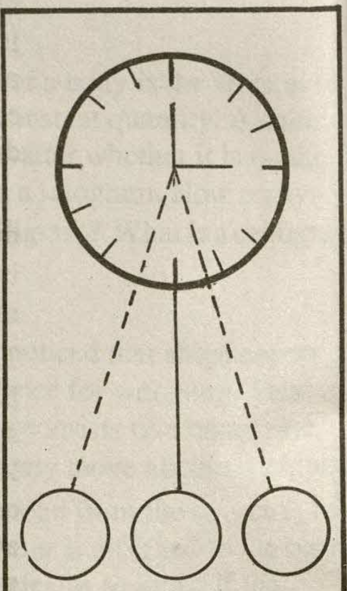
From ancient times the length of the day has been used as the unit of time. The day is divided into 24 hours and one hour contains 60 minutes. One minute contains 60 seconds. The SI unit of time is the second.

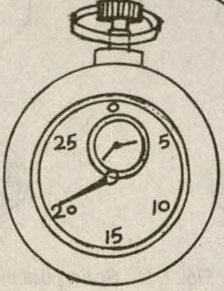
You are familiar with some methods of measuring time.

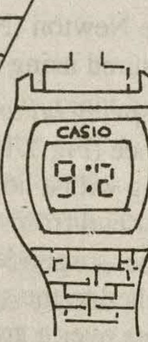
Activity 11 : *Given below are pictures of some timing devices. Find out their names and how they work. Collect or draw pictures of various timing devices and make a chart for your classroom.*











You have already learnt that the time taken for one to-and-fro motion of a pendulum i.e., for one oscillation, is the same whether the arc of swing is small or large. This is called the *time period.*

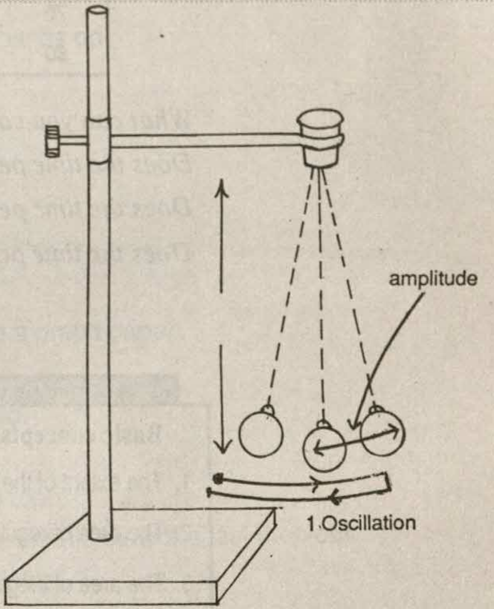
A pendulum can be made by tying a cotton thread to a small metal ball called a *bob*. The other end of the thread is fixed to a support.

When the bob is pulled aside slightly and then released, it starts to oscillate. The time taken for one complete osicillation is found to be the same even if the size of the bob is changed. The time period of oscillation changes with the length of the string.

Activity 12 : *Find out what factors affect the time period of oscillation of a pendulum.*

Things needed : A stand with clamp, split rubber cork, some thread, bobs of at least three different sizes, stop clock.

1. Tie equal lengths of thread to all the three bobs of different sizes. Fix the first bob with the string between the split cork and tighten the clamp. Displace the bob from its rest position and allow it to oscillate. Start the stop clock when the bob is in the extreme position (a) and count upto 10 oscillations of the pendulum. Note the time on the stop clock. Repeat the experiment and note down the time. Then remove the bob and string and repeat the procedure with two other bobs using the same length of string.



	Time for 10 oscillations			*Time for 1 oscillation T sec*
	1 sec	*2 sec*	*average sec*	
1st bob				
2nd bob				
3rd bob.				

2. Suspend any bob from a string and find the time period for various amplitudes of swing.

Amplitude	Time for 10 osc sec	Time period T sec
small		
medium		
large		

3. Set up the pendulum with a certain length (say 60 cm) and find the time period. Increase the length to 70 cm and 80 cm consecutively and find the time period of oscillations

Length cm	Time for 10 oscillations sec			Time period T sec
	1	2	average	
60				
70				
80				

What can you conclude from the above three experiments ?

Does the time period depend on the mass of the bob?

Does the time period depend on the amplitude of swing?

Does the time period depend on the length of the pendulum?

Basic concepts

1. The extent of the surface of a body is called its area.
2. The area of regular figures can be determined from their dimensions.
3. The area of irregular figures can be found using a graph sheet.
4. The SI unit of volume is cubic metre or m^3.
5. Volume is also measured in litres. The volume of 1 kg of water is 1 litre. 1 litre = 1000 c.c.
6. A pipette is used for measuring small but definite volumes of a liquid.
7. The burette is used for measuring accurately, exact quantities of a larger amount of liquid.
8. The time period of a pendulum increases with length and is independent of the mass of the bob and the amplitude of the oscillation.

REVISION

I Choose the correct answer :

1. The SI unit of area is
   a. cm^2.
   b. cc.
   c. litre.
   d. m^2.
2. The volume of an irregular solid can be determined by using
   a. a pipette.
   b. an overflow jar.
   c. a burette.
   d. a conical flask.
3. The SI unit of weight is
   a. gm.
   b. kg.
   c. newton.
   d. litre.
4. The time period of oscillation of a simple pendulum depends on
   1. amplitude.
   2. length.
   3. mass of the bob.
   4. none of the above.

II . State whether true or false.

1. 1 square metre = 10,000 sq cm.
2. The area of an irregular figure can be detemined using a graph paper.
3. The volume of a sphere is $1/3 \pi r^3$.
4. A pipette is used for measuring small quantities of liquid.
5. The graduations in a burette are from bottom to top.
6. The graduations in a measuring jar are from bottom to top.
7. When measuring the volume of liquid with a pipette we should blow the last drop out.
8. The volume of a lead shot can be determined with a pipette.
9. Mass and weight mean the same thing.
10. The hour glass is an accurate method of measuring time.

III. Fill in the blanks with suitable words.

1. The system of units we use is called the __________________ system of units.
2. A pipette is used for measuring __________________ of a liquid.
3. A burette is used to measure __________________ of a liquid.

4. An overflow jar is used for __________________ .
5. The area of an irregular body can be found using a __________________ .
6. The principle of a pendulum was discovered by__________________ .
7. Weight is measured in the unit of __________________ .
8. The unit of weight is __________________ .
9. The time period of a pendulum changes with __________________ .
10. If the volume of 100 lead shots is c.c, the volume of one lead shot is __________________

IV. *Match the following :*

1. irregular area	a. kilogram
2. mass	b. measuring cylinder
3. volume of lead shot	c. pipette
4. irregular volume	d. newton
5. weight	e. graph paper
6. small definite volume	f. time period
7. pendulum	g. burette

V. *Answer the following questions :*

1. How will you find the area of a leaf using a graph paper?
2. Describe the burette with a neat diagram.
3. Draw a neat diagram of a pipette and describe it.
4. How will you use the burette to measure the volume of a glass bead?
5. How will you use the pipette to measure out a given quantity of liquid?
6. How will you find the volume of a piece of stone using (a) measuring jar (b) overflow jar?
7. How will you show that the time period depends on length?
8. The shape of an irregular piece of glass was drawn on a graph paper and the number of big squares counted was 5. The number of small squares was 56. What was the total area of the glass piece ? Write your answer in sq cm and sq mm. (Ans: 556 sq mm or 5.56 sq cm)
9. The level of water in a burette is 24.6 c.c. When 20 lead shots are put in it, the level rises to 24.2 c.c. Find the average volume of one lead shot. (Ans: 0.02 c.c.)

2. Mechanics

Simple machines - machines and energy - transformation of energy - machine maintenance and care - friction, methods of reducing friction - centre of gravity.

2.1 Simple machines

We usually think of a machine as a number of complicated parts properly designed and fitted together to do some special kind of work. If we were to examine each part of a machine we would find that they are built on the principles of some simple devices used over and over again. These simple devices can be made to do work for us, and are called simple machines. Simple machines make work easier for us.

SIMPLE MACHINES MAKE WORK EASIER

In a simple machine the force exerted at a certain point and in a certain direction is made available at some other point and in some other direction. It thus helps us to do work more easily than with our unaided muscles.

Machines are used for the following general purposes :

1. To change the direction of the force so that we can apply force in a more convenient direction e.g., the pulley systems.
2. To gain force, i.e., to reduce effort. Here we use a small effort to lift a large load.
3. To gain time, i.e., by increasing speed i.e., work can be done faster.

Mixers, grinders, etc. do save a lot of time and energy but they are not simple machines.

An advantage is gained by using a machine which reduces the force needed to lift a load. This factor is called the mechanical advantage (MA).

Mechanical advantage is defined as the ratio of the load to effort.

$$MA = \frac{\text{load overcome}}{\text{effort applied}}$$

THE INCLINED PLANE

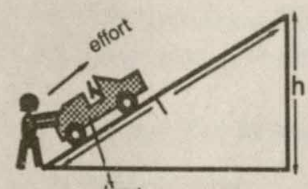


Fig. 2.1 Principle of the inclined plane

This is one of the simplest of all machines used to raise heavy loads. The main function of the inclined plane is to raise heavy loads from one position to another.

In the example 2.1 the man moves the load through a distance l of the inclined plane in order to raise the load through a height h. Which distance is greater ?

Also, the effort depends on the angle of inclination. For the same length l, you will notice that as the height h varies it alters the angle of inclination. How?

Inclined planes may be used to lift loads from the ground to a lorry by moving it along a sloping platform (Fig 2.2.). Other applications include ramps in multi-storey carparks and roads over mountains where a series of inclined planes are joined by hair-pin bends (Fig 2.3).

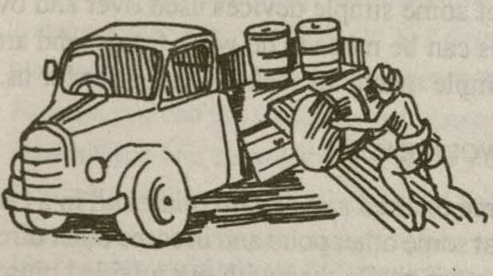


Fig. 2.2

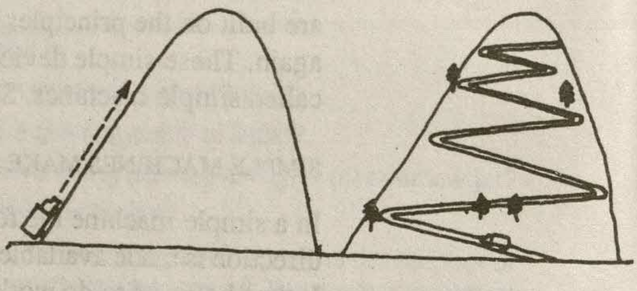


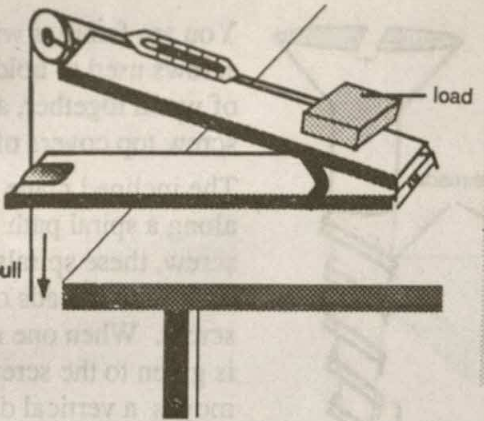
Fig. 2.3

Activity 1 : *Draw or collect pictures of 3 different applications of inclined plane apart from those mentioned here.*

Activity 2 : *To find the force required to pull up a load along an inclined plane at different angles :*

Things neded : Inclined plane apparatus or a plank and some blocks, of wood or books, a heavy load, a spring balance and some string.

The inclined plane apparatus consists of two planks of wood hinged together and an adjustable bracket fitted with a screw and a butterfly nut.



The two planks can be kept at any desired angle and the nut tightened . Fix a pulley to the top of the inclined plane.

Fix the inclined plane at any angle. Attach a load to a spring balance by a string and slowly pull the load up the plane. Note the reading of the spring balance when the load just starts moving. Now increase the angle of incline and repeat the procedure for four different angles of inclination.

What conclusion can you draw from this experiment? If the above apparatus is not available, then the angle can be changed by raising one end of the plank above the other with wooden blocks or books (Fig. 2.4).

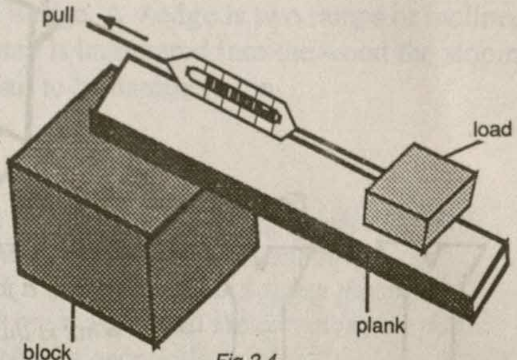


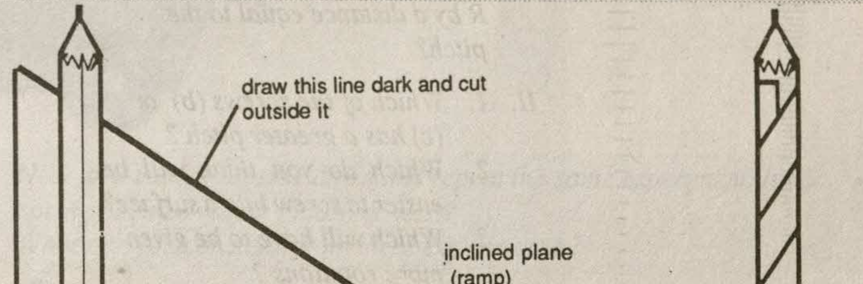
Fig 2.4

THE SCREW

The screw is a simple machine formed by "rolling up" an inclined plane.

Activity 3 : *Cut out a right–angled triangle (ramp) from a sheet of paper. Roll the ramp around the pencil.*

What have you made ?



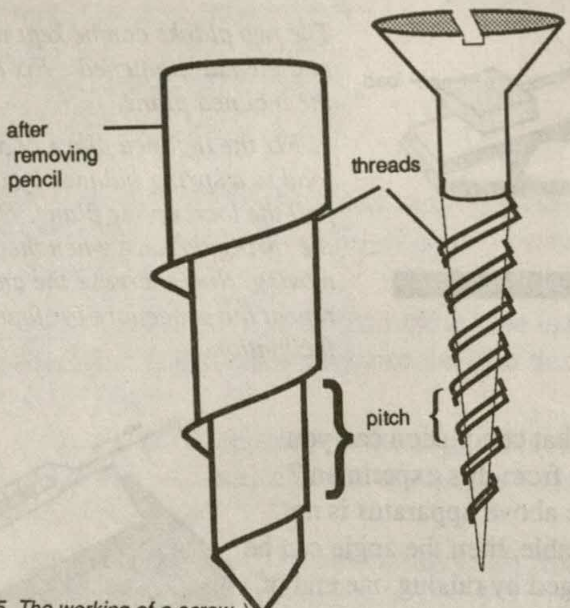
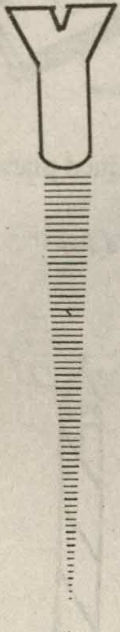
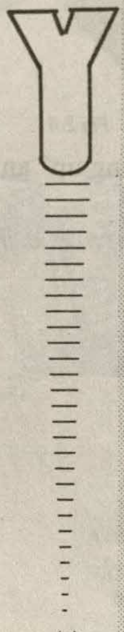


Fig. 2.5 The working of a screw

You are familiar with the screws used to hold piece of wood together, and the screw top covers of bottle

The inclined plane is now along a spiral path. On an screw, these spirals are called the threads of the screw. When one rotatio is given to the screw, it moves a vertical distance equal to the distance between one screw thread and another. This distanc is called the pitch of the screw.

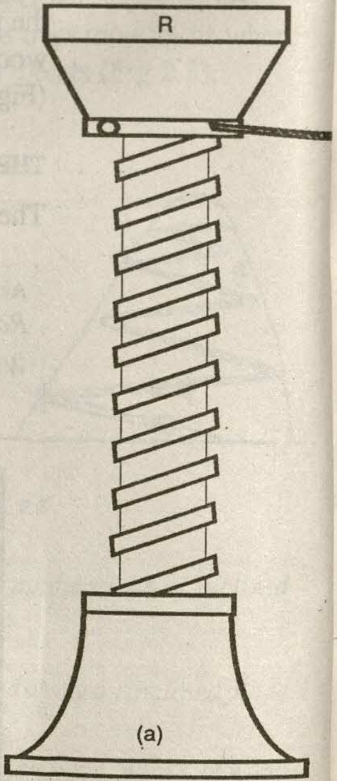

(b)


(c)

Activity 4 : *I. The diagram (a) shows the figure of a jack screw.*

1. *What is this machine used for ?*
2. *What is meant by the pitch of the screw ?*
3. *Mark the pitch on the diagram.*
4. *The effort is applied on the handle at E. How much should the handle be rotated to raise R by a distance equal to the pitch?*

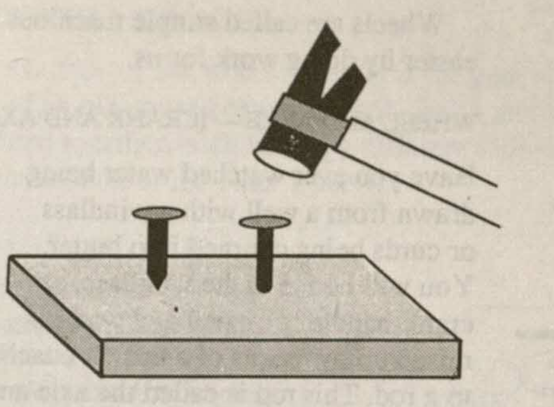
II. 1. *Which of the screws (b) or (c) has a greater pitch ?*
  2. *Which do you think will be easier to screw into a surface?*
  3. *Which will have to be given more rotations ?*



(a)

THE WEDGE

Activity 5 : *Buy a few iron nails. Choose two nails, one blunt and the other sharp. Try to hammer them both into a piece of wood.*
Which nail is more difficult to hammer in ?



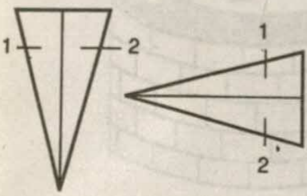
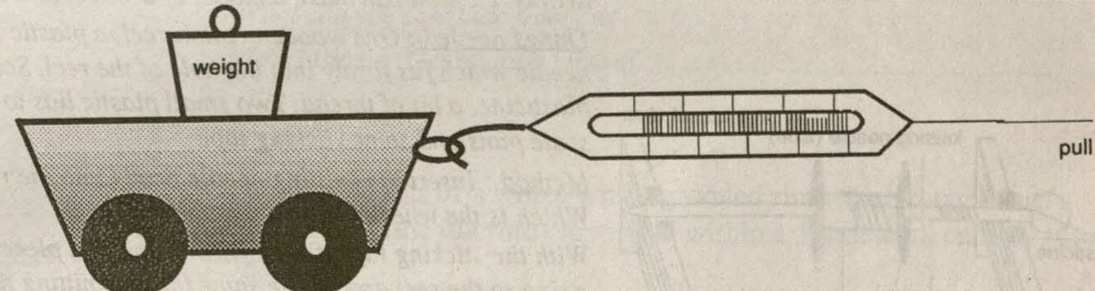


Fig 2.6 A wedge

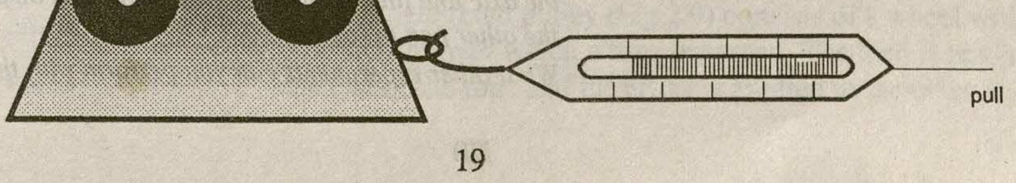
The end of the sharp nail is a wedge. A wedge is two ramps or inclined planes back to back. As the nail is hammered into the wood the sloping edges make it easier for the nail to be hammered in.

WHEELS

Activity 6 : *Things needed : A small toy cart, a spring balance, a small heavy object to increase the weight of the cart and some string.*
Place the cart on the floor with the weight on it and attach the spring balance to it (if necessary with the string). Pull the cart along the floor and note the reading of the spring balance.
What does this reading represent ?



Now turn the cart upside down and repeat the same experiment. Is the spring balance reading more or less ?
What can you conclude from these experiments ?



Wheels are called simple machines because they make our work easier by doing work for us.

WHEEL AND AXLE — (CRANK AND AXLE)

Have you ever watched water being drawn from a well with a windlass or curds being churned into butter. You will notice in the windlass, a crank-handle is rotated and water is raised up by means of a bucket attached to a rod. This rod is called the axle and the crank which rotates through a larger radius is the wheel. The effort is applied at the wheel and the load is raised by the axle. The mechanical advantages is given by

$$\text{M.A.} = \frac{\text{radius of the wheel}}{\text{radius of the axle.}}$$

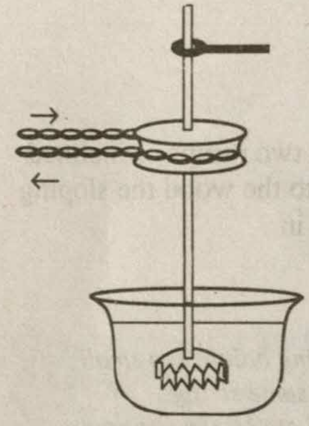


Fig 2.8 A butter churner

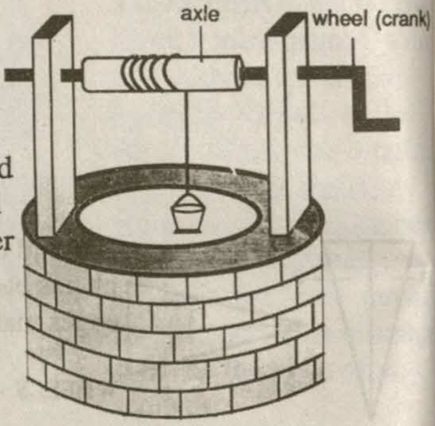
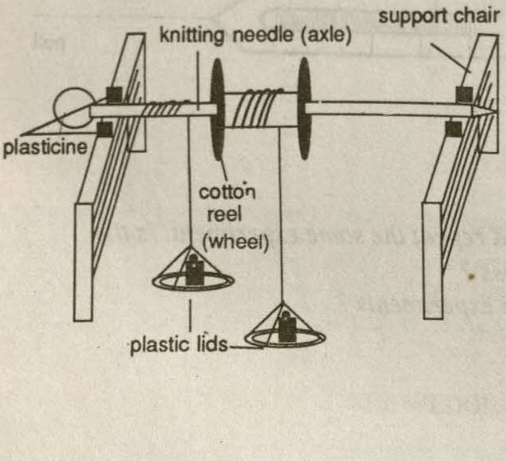


Fig 2.7 The windlass

Other examples of the wheel and axle are the door knob, the steering wheel, the grinder. Can you think of other examples where a crank or a wheel does work for you ?



Activity 7 : *You can make a model of a wheel and axle.*

Things needed : One wooden cotton reel, a plastic knitting needle which fits firmly into the hole of the reel. Some plasticine, a bit of thread. Two small plastic lids to use as scale pans and some sticking tape.

Method : Insert the knitting needle firmly into the reel. Which is the wheel and which is the axle ?

With the sticking tape, firmly fix one end of a piece of string to the reel and do the same for the knitting needle. Wind the string around the wheel and axle in opposite directions. Attach scale plans (plastic lids) to the free ends of the string as shown. Place the free ends of the knitting needle on two supports (two chairs will do). Put a bit of plasticine on either side of the knitting needle on the support to prevent it from slipping.

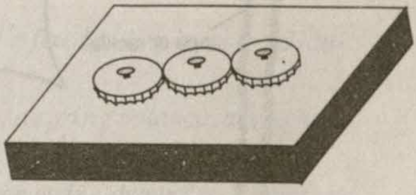
Now put a load, say a 50 gm weight on the pan attached to the axle and find out how much weight must be placed on the other pan to raise it.

What other experiments can you perform with this model?

MODEL OF WHEEL AND AXLE

Another example of the wheel and axle is the gear wheel. If you open the back of an old unused clock you will find a number of toothed wheels fitted together, each having a different radius. Rotate one wheel and see the motion of the other wheels.

Activity 8 : *To observe how gear wheels work.*



Things needed : Three covers from soft drink bottles, three thin nails, one large nail and a piece of wood.

Method : Punch a hole through the centre of each cap with a nail. Place the caps close to each other on the piece of wood so that they touch each other and fix them in their places by hammering in the thinner nails into the three holes. The caps should be able to rotate freely.

Now turn one of the caps with your finger. Do the other caps turn ? Which direction do they turn ? — in the same direction or opposite directions ? If one of them had a much smaller radius than the other, would it rotate through the same number of rotations?

What can you conclude from this ?

Conclusion : Gears are a form of................. ....

THE PULLEY

A pulley consists of a wheel with a grooved rim which rotates freely about an axis (the fulcrum) supported within a framework called a block.

SINGLE FIXED PULLEY

This is used to raise a flag to the top of a flag-pole. Builders use a single pulley to lift bricks, cement and other materials. The pulley only changes the direction of the force. It is more convenient to be on the ground and to pull downwards than to pull upwards. A single fixed pulley operates as a lever of the first order.

The single fixed pulley (Fig.2.9) consists of a wheel with a grooved rim over which a rope is passed. The load is applied to one end of the rope and the effort is applied to the other end.

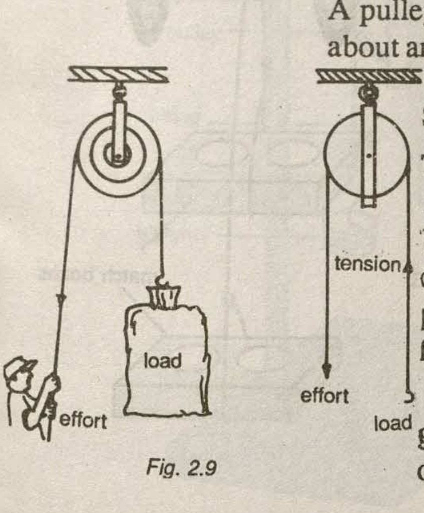


Fig. 2.9

Acc. no.-15476

The tension in the rope is equal to the effort and is the same throughout the rope. So if we neglect (a) the weight of the rope itself and (b) friction at the pulley, then load = effort.

Therefore, mechanical advantage

$$= \frac{\text{load}}{\text{effort}} = 1.$$

The effort and the load move through exactly the same distances since they are at the ends of the same rope.

In practice, the effort is always greater than the load and the mechanical advantage is less than 1.

Fig. 2.10 shows you some ways in which a single fixed pulley is used.

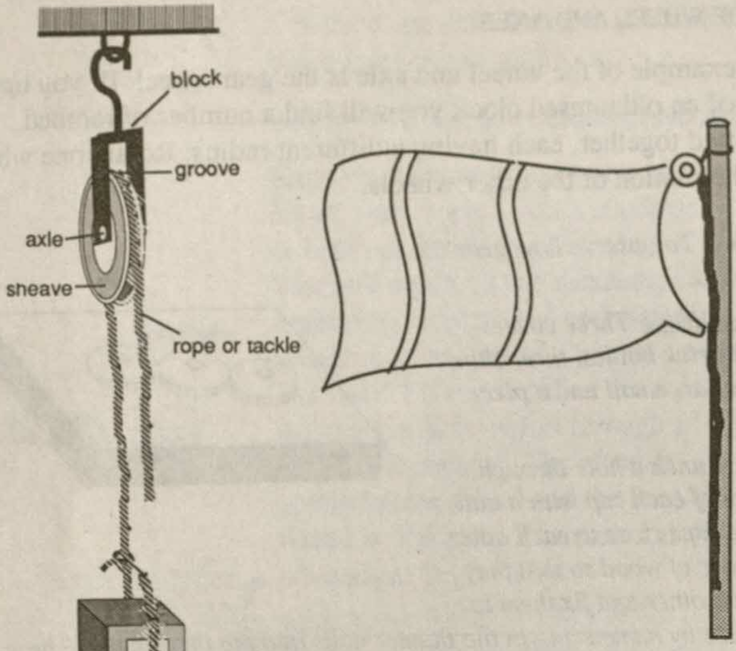
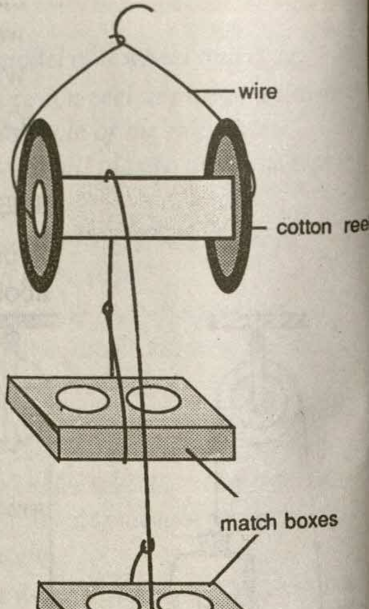


Fig . 2.10 Using a single fixed pulley

Activity 9 : *Collect pictures and make a chart showing the various uses of the pulley.*

Activity 10 : *Make your own fixed pulley. The diagram given alongside shows the things needed. This is only a suggestion. You can think of other ways of making a pulley. If you have a mechano-set there will be pulleys there which you can use.*



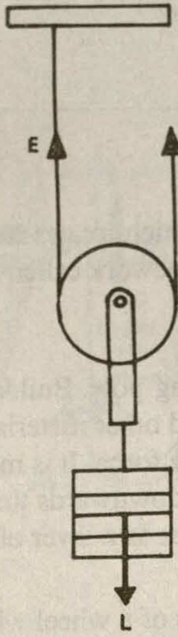


Fig 2.11 A single movable pulley

SINGLE MOVABLE PULLEY

If the block on which the pulley is fixed is movable, the pulley is said to be a movable one (Fig. 2.11). The movable pulley has all the characteristics of a lever of the second class and is able to multiply the effort applied. One end of the rope is attached to a fixed support and the effort is applied to the other end of the rope. The load is attached at a point just below the fulcrum. The rope applies two efforts to the load, each acting on either side of the pulley in an upward direction. Since the effect of the effort has been doubled, the effort required to raise the load will be only half the value of the load.

$$\text{M.A.} = \frac{\text{load}}{\text{effort}} = 2$$

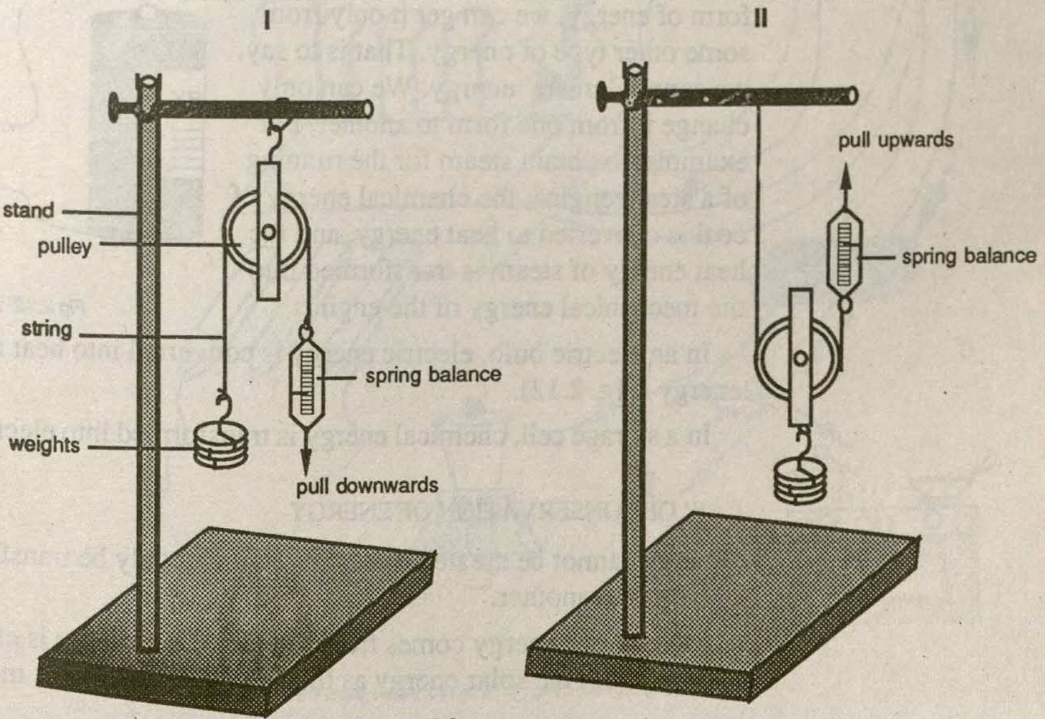
Activity 11 : *Do this experiment to find out if a fixed pulley is more advantageous or a movable pulley.*

Things needed : *A stand, a pulley, a string, a spring balance, a weight box or slotted weights.*

I. Suspend the pulley from the stand. Pass the string around it. To one end of the string attach some weights. To the free end of the string attach the spring balance. Pull the spring balance downwards and note the reading when the weight is just about to move upwards.

II. Attach the string to the stand and the free end to the spring balance as shown. Support the pulley on the string with the same weight attached to it as in I. Pull the spring balance upwards and note the reading of the spring balance.

Which reading is less ? Why ?



2.2. Machines and energy.

Both men and machines do work. The ability to do work is called energy. Energy is needed for them to do work. Energy like work is measured in joules.

FORMS OF ENERGY

Where did the energy to do work come from originally ? From man, o course. He used up chemical energy which he obtained from the food he ate. When machines do their work, their energy comes from the fuel they use. A car uses chemical energy from the burning of petrol. An electric motor uses electric energy. The energy of a battery comes from the chemicals in it.

Activity 12 : *A few types of energy are discussed above. What other types of energy have you learnt about ? Where are they used ? Collect or draw pictures and make a chart showing the different forms of energy and their uses in various machines.*

2.3 Transformation of energy

You now know that energy can exist in many forms. When we want a particular form of energy, we can get it only from some other type of energy. That is to say, we cannot 'create' energy. We can only change it from one form to another. For example, to obtain steam for the running of a steam engine, the chemical energy of coal is converted to heat energy, and the heat energy of steam is transformed into the mechanical energy of the engine.

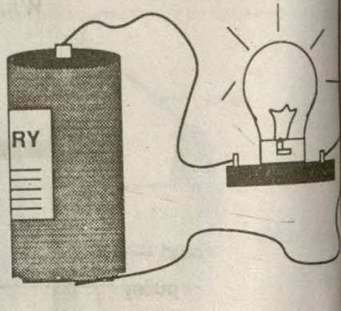


Fig 2.12 A storage cell

In an electric bulb, electric energy is converted into heat and light energy (Fig. 2.12).

In a storage cell, chemical energy is transformed into electrical ener

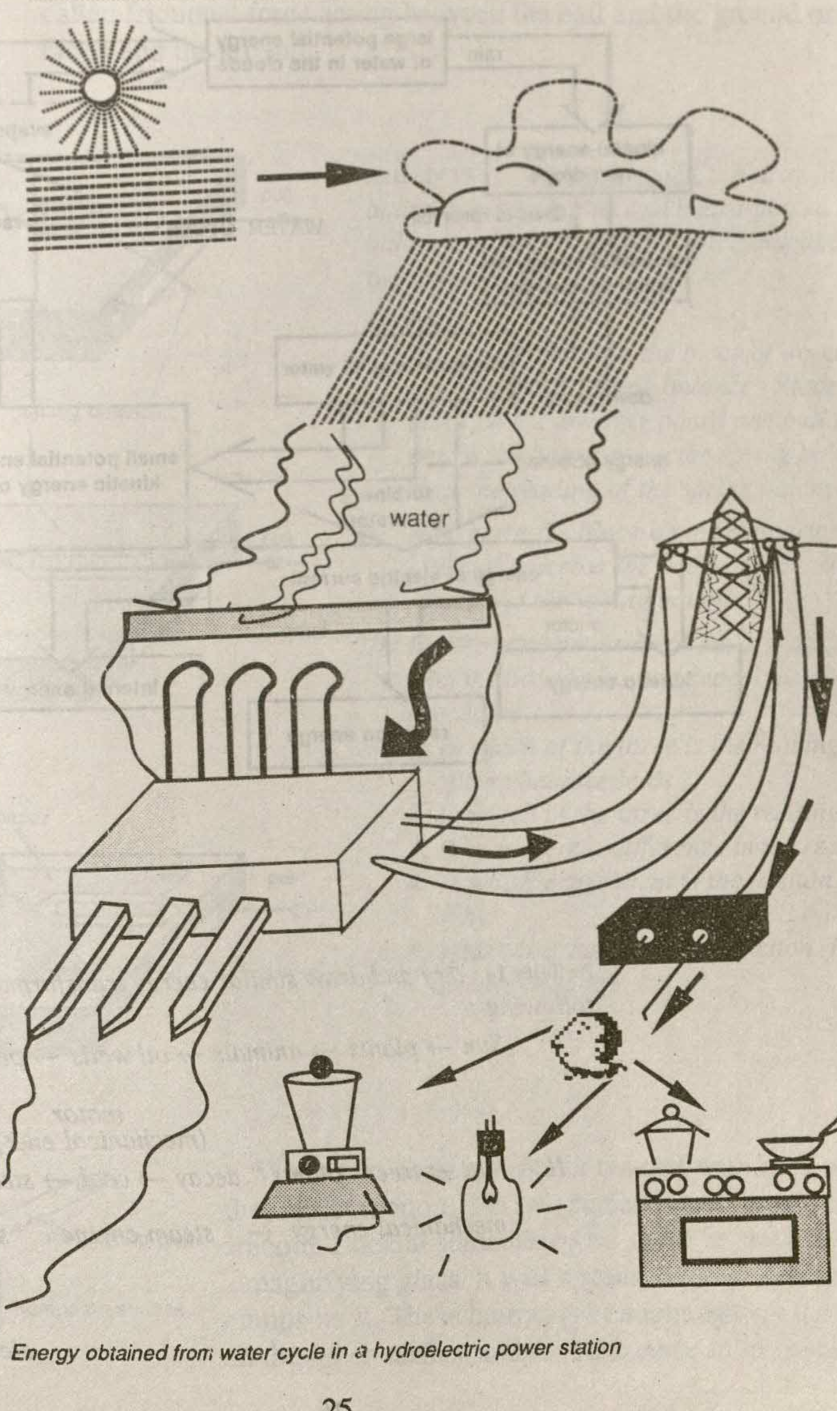
LAW OF CONSERVATION OF ENERGY

'Energy cannot be created or destroyed it can only be transformed fro one form to another.'

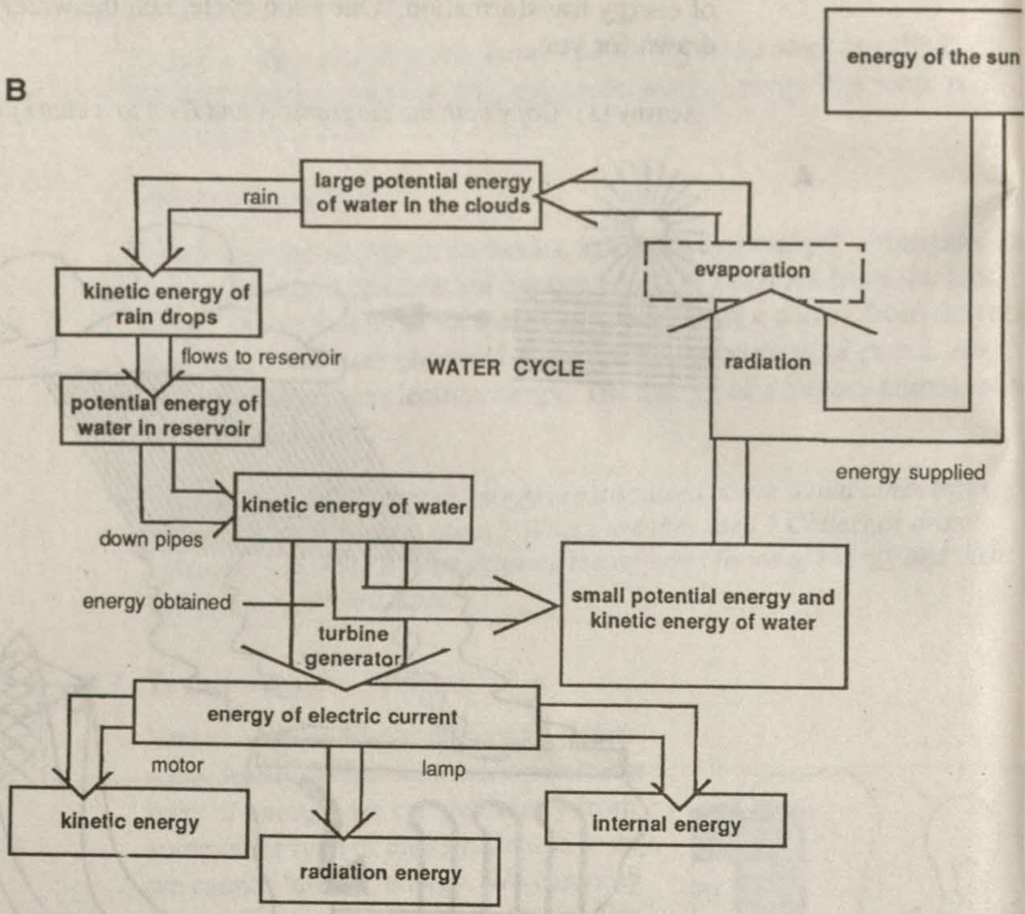
Most of our energy comes from the sun. This energy is called *sola energy*. With the solar energy as the source, we can trace many "cycl of energy transformation. One such cycle, i.e., the water cycle has been drawn for you.

Activity 13 : *Copy both the diagrams A and B on to a chart paper.*

A



Energy obtained from water cycle in a hydroelectric power station



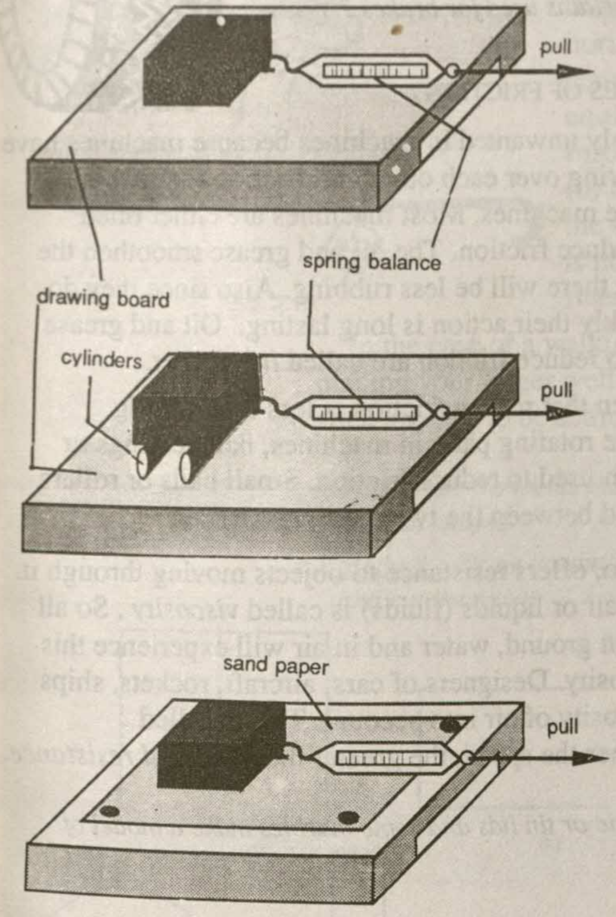
Activity 14 : *Try and draw similar energy transformation charts for the following :*

I. Sun → plants → animals → oil wells → petrol (photosynthesis)
↓
motor ← heat energy
(mechanical energy) (combustion)

II Sun → trees . plants " decay → coal → steam (heat energy)
↓
mechanical energy ← steam engine steam turbine
↓
electricity
↓
electrical gadgets

2.4 Machine maintenance and care — friction.

If you roll a ball on the ground or push a wooden block on it, you will find that they both stop moving almost immediately, because of a force called frictional force acting between the ball and the ground or the block and the ground.



Activity 15 : *Things needed : A drawing board, some tack-pins and board-pins, a spring balance, a block of wood, some sandpaper and two cylindrical rods.*

Method :

I. Fix a tack nail onto the block of wood and attach it to the spring balance. Place the block on the drawing board and pull it across the board using the spring balance. Note the reading of the spring balance.

II. Now place the block on the cylindrical rod and pull it across the board again. Note the reading of the spring balance

III. Fix the sand paper on to the drawing board with the board pins and repeat the above procedure.

1. In which of the three is the reading of the spring balance least ?
2. In which of the three is the reading most?
3. Why is there a difference in the readings?
4. In which experiment is the friction most? Why?
5. Which is greater, rolling friction (II) or sliding friction?

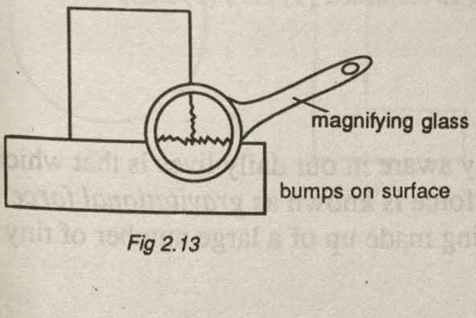
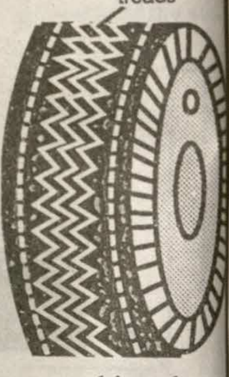


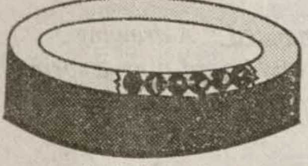
Fig 2.13

When two objects move in contact with each other, they resist motion. No two surfaces are completely smooth. Look at something you think is smooth under a magnifying glass. It will appear to have a number of bumps on it. These bumps get caught against the bumps on the other surface and the resistance to motion that results is called friction. You cannot see friction but you can see what it does. Friction has its advantages and disadvantages.

Activity 16 : *Questions to think about :*

1. *Would we be able to walk on the ground if there were no friction?*
2. *Why are the tyres of vehicles treaded ?*
3. *Why do people slip on banana skins ?*
4. *What kind of material is used for brakes ?*




(a) ball bearing

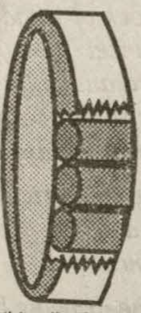

(b) roller bearing

Fig. 2.14 a. Ball bearings
b. Roller bearings

DISADVANTAGES OF FRICTION

Friction is mainly unwanted in machines because machines have many parts moving over each other and friction reduces the efficiency of the machines. Most machines are either oiled or greased to reduce friction. The oil and grease smoothen the surfaces so that there will be less rubbing. Also since they do not dry up quickly their action is long lasting. Oil and grease used this way to reduce friction are called *lubricants*.

We have already seen that rolling friction is less than sliding friction. When there are rotating parts in machines, ball bearings or roller bearings are often used to reduce friction. Small balls or rollers made of steel are placed between the two moving surfaces.

Streamlining : Air, too, offers resistance to objects moving through it. The frictional force of air or liquids (fluids) is called *viscosity* . So all vehicles which move on ground, water and in air will experience this opposing force of viscosity. Designers of cars, aircraft, rockets, ships etc., must take the viscosity of air into account. This is called *streamlining*. The higher the speed, the greater the *frictional resistance*.

Activity 17 : *Using plastic or tin lids and some marbles make a model of ball bearings.*

Activity 18 : *Draw pictures showing streamlined (1) cars (2) ships (3) aeroplanes.*

2.5. Centre of gravity

The force which we are constantly aware in our daily lives is that which pulls all bodies to the earth. This force is known as *gravitational force*. Any body may be regarded as being made up of a large number of tiny

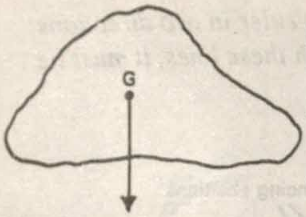


Fig. 215 Centre of gravity

particles. Each of these particles is pulled to the earth. No matter what shape an object has, the weight is spread over the whole object. But the pull of the earth, that is, the weight of the object, acts as if it were concentrated at a certain point. This point is called the centre of weight or the centre of gravity of the object.

The centre of gravity of a body is the point where its entire weight may be considered to act.

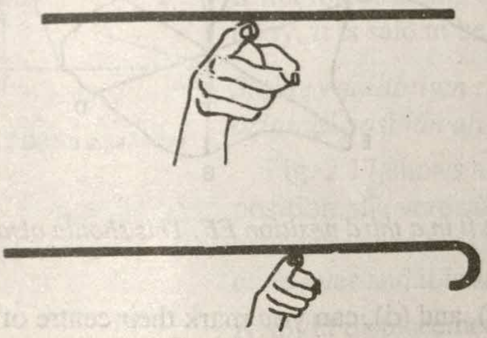


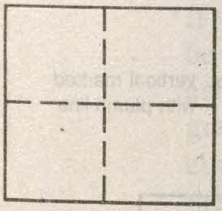
Fig. 2.16

If you try to balance a ruler horizontally on your finger, you will notice that it will only remain horizontal if your finger is vertically below the centre of gravity (Fig. 2.16). The ruler is now in equilibrium under the action of two forces, (a) the force of gravity acting vertically downwards, and (b) the equal and opposite reaction of the finger to the weight of the ruler, acting upwards. If the finger is not vertically below the centre of gravity, the ruler will topple over.

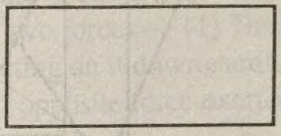
In the case of a walking stick, however, you can only balance it by placing your finger well away from the middle. The entire weight of the stick appears to be acting at a point nearer the handle.

Activity 19 : *To locate the position of the centre of gravity for laminae of various shapes.*

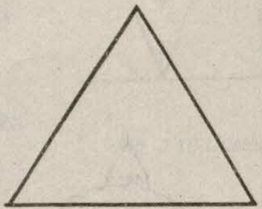
Method : Draw the outline of the shapes given below on the cardboard and cut them out.



(a)

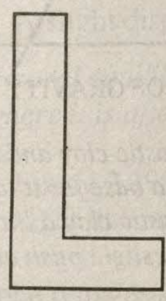


(b)

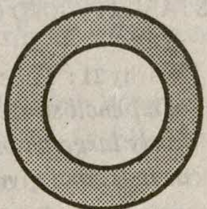


(c)

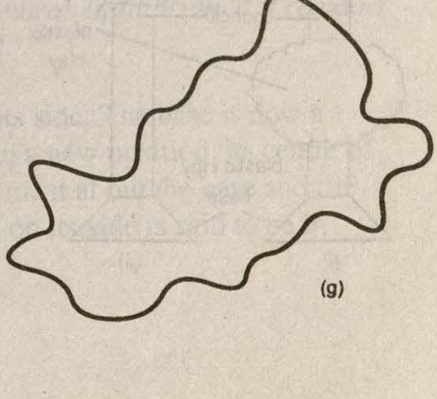
(d)



(e)

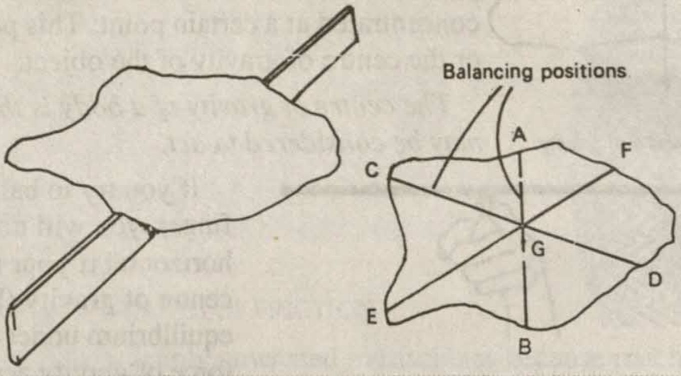


(f)



(g)

Balance the laminae one by one on the edge of the ruler in two directions AB and CD. Since the centre of gravity lies on both these lines, it must lie at the point where they intersect (G).

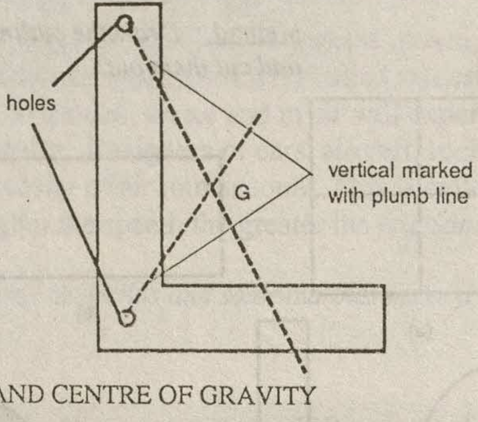


To check this you can balance it in a third position EF. This should also pass through G.

For the laminae (a), (b), (c), and (d), can you mark their centre of gravity without balancing them? How?

Where does the centre of gravity lie for shapes like (e), (f) and (g)?

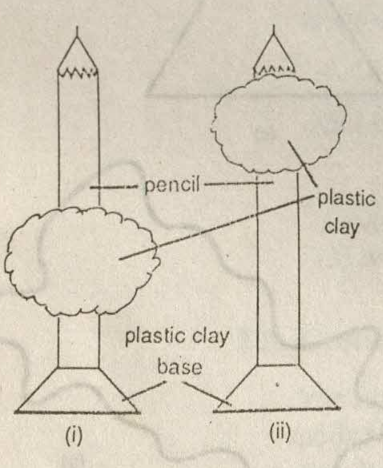
Activity 20 : *If the shape is that of (e) you will have to place it on a paper after marking the positions of the centre of gravity as shown below. The lines will meet at a point outside the lamina on the sheet of paper.*



STABILITY AND CENTRE OF GRAVITY

Activity 21 : *Take some plastic clay and attach some to one end of a pencil so as to make a base for it to stand. Now stick a fairly large amount of plastic clay a little higher than the base as in (i) and give it a very slight push at its tip.*

Does the pencil fall ? Why ?



Now remove the plasticene from lower down and fix it at the top as shown in (ii). Give the tip a very slight push. Does the pencil fall? Why? What is the difference between (i) and (ii)? What changes when the position of the plasticene is altered?

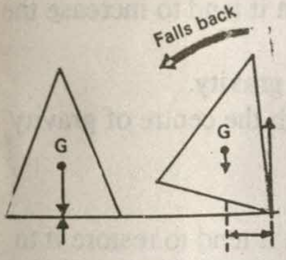


Fig. 2.17 Stable equilibrium

STATES OF EQUILIBRIUM

If the forces acting on a body produce no change in the position of a body, it is said to be in equilbrium.

Stable equilibrium : An object is in stable equilibrium if it returns to its original position after being slightly displaced.

Fig. 2.17 shows a cone standing on its base. If it is tilted from this position, the vertical force (weight) through the centre of gravity *G* will cause the cone to fall back on the base *AB*. It is not easy to knock the cone over and it is said to be in stable equilibrium.

A slight displacement raises the centre of gravity.

Unstable equilibrium : An object is in unstable equilibrium if it moves further away from its original position after being slightly displaced.

A cone cannot be made to balance on its tip. This will be possible only if the cone could be placed with its centre of gravity in a vertical line through the tip. If we could do this, then the cone would be in a state of equilibrium under the action of two forces — (1) The force of gravity acting on it downwards, and (2) an equal and opposite force exerted on it by the table.

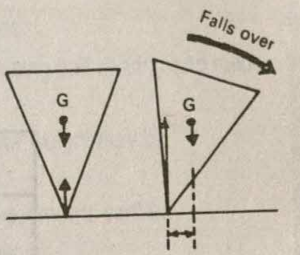


Fig. 2.18 Unstable equilibrium

A slight displacement lowers the centre of gravity.

Neutral equilibrium : An object is in neutral equilibrium if it remains where it is after being slightly displaced.

Figure 2.19 shows the cone lying on its side. The base is now a straight line, and if the cone is rolled into a new position, its centre of gravity does not change. There is no moment about the base and the cone remains where it is. A cone placed on its side is said to be in neutral equilibrium.

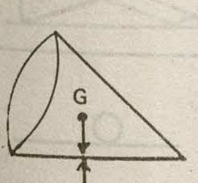


Fig. 2.19 Neutral equilibrium

The centre of gravity of any body tends to occupy the lowest possible position.

Hence, an object is in unstable equilibrium when

(i) it is slightly displaced, the forces acting on it tend to increase the displacement.
(ii) a slight displacement lowers the centre of gravity.
(iii) when tilted, the vertical line drawn through the centre of gravity falls outside the base.

A body is in stable equilibrium when,

(i) it is slightly displaced the forces acting on it tend to restore it to the original position, i.e., tend to decrease the displacement.
(ii) a slight displacement raises the centre of gravity.
(iii) if tilted, the vertical line through the centre of gravity falls within the base.

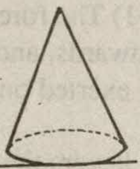
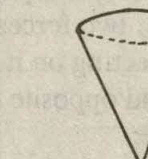
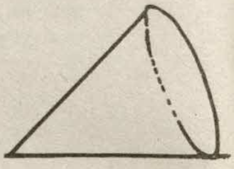
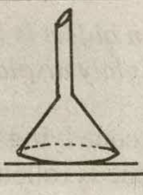
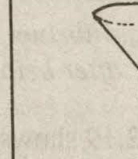
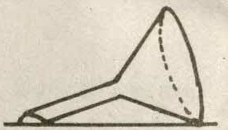
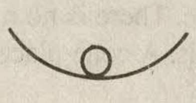
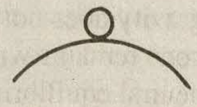
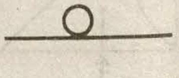
A body is said to be in neutral equilibrium

(i) when it is slightly displaced, it remains in its new position.
(ii) a slight displacement neither lowers nor raises the centre of gravity.

Examples of stability : An object tends to fall when its centre of gravity is outside the base that supports it.

Many articles are made stable because

(a) their centres of gravity are as low as possible and
(b) their bases are as broad as convenient. Examples are conical flasks, bunsen burners, wine-glasses, reading-lamps, candle-sticks, blackboard stands, buses and cars.

	Stable	Unstable	Neutral
Cone			
Funnel			
Sphere			

If the centre of gravity of a bus or car falls outside its wheels, the bus turns over. Passengers are not allowed to stand on the upper deck of double-decker buses because they would raise the centre of gravity of the bus and make it less stable.

Putting baggage on the roof of a car raises the centre of gravity and makes the car less stable. Some kerosene lamps have lead in their bases; the centre of gravity is so low that they do not fall over easily.

Basic concepts.

1. Simple machines make work easier
2. The inclined plane is an example of a simple machine.
3. The screw is an example of a simple machine
4. The wheel and axle is an example of a simple machine.
5. The wedge is an example of simple machine.
6. Gears are a form of simple machine.
7. Pulleys are a form of simple machine. A single movable pulley is more advantageous than a single fixed pulley. Machines need fuel to do work.
8. Energy is of different types or forms.
9. Frictional force comes into play when bodies move over each other.
10. Friction is sometimes necessary and harmful at often times.
11. Friction in machines can be reduced by lubrication or by using ball bearing and roller bearings etc.
12. The centre of gravity of a body is the point where the entire weight may be considered to act.
13. The centre of gravity of a body of regular shape is at the geometric centre.
14. The centre of gravity of some bodies lies outside the body.
15. The stability of a body depends on the position of its centre of gravity.

Some investigatory projects/activities

1. *Write an imaginative essay on If there were no friction" or make a chart on the same topic.*
2. *Make a list of a objects in and around school or home which show (a) stable (b) unstable (c) neutral equilibruim.*

REVISION

I. Choose the correct answer.

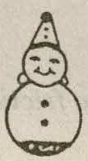
1. An example of the inclined plane is
   a. The wheel and axle. b. The screw. c. Single fixed pulley. d. Single movable pulley.
2. The ratio of the load to effort is
   a. work output. b. resistances. c. power. d. mechanical advantage.
3. A single fixed pulley is used to
   a. increase speed. b. increase the efficiency. c. change the direction of the force applied. d. decrease the load.
4. A floor lamp can be made more stable by
   a. placing a heavy weight on top of it. b. increasing the area of its base. c. using a larger lamp shade. d. None of the above.

II Fill in the blanks :

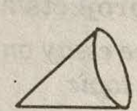
1. A hair pin bend is an example of ....
2. The distance moved by a screw when one rotation is given to it is called its ....
3. A screw is an example of an ....
4. The greater the angle of inclination the .... the force required.
5. Gears are a form of ....
6. The simple machine used in flag hoisting is ....
7. Energy can neither be .... or ....
8. Most of our energy comes from the ....
9. The force which opposes the motion of one body over another is called....................... .
10. Vehicles are .... to reduce the frictional force of air.
11. If the forces acting on a body produce no change in the position of the body, it is said to be in ....
12. The centre of gravity of a body is the point ....

III. Which state of equilibrium are the following in?

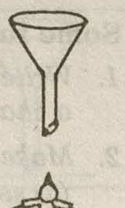
A



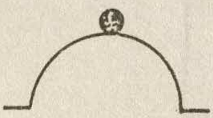
B



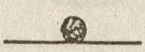
C



D



E



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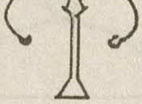


IV. *State whether true or false.*

1. The stability of a body depends on the position of its centre of gravity.
2. A metre scale suspended at the centre of gravity is in neutral equilibrium.
3. A cone lying on its base is in neutral equilibrium.
4. The gear box is an application of wheel and axle.
5. The centre of gravity of a body tends to occupy the highest position
6. We can do without friction altogether.
7. The wedge is an example of an inclined plane.
8. Longer handles help to reduce the effort.
9. Frictional force acts in the direction of motion of a body.
10. Corrugated tyres of vehicles avoid skidding.

V. *Answer the following questions :*

1. What is a simple machine ?
2. Why are machines used ? Give three reasons.
3. Describe the action of a screw as an inclined plane.
4. How do wheels make our work easier ? Give examples.
5. Describe an experiment to determine whether a single fixed pulley is less advantageous than a single movable pulley.
6. Explain with experiments the meaning of (a) sliding friction (b) rolling friction.
7. Give two examples of cases where friction is disadvantage?
   (a) wanted friction (b) unwanted friction.
8. What is streamlining ?
9. What are lubricants ?
10. Write a note on 'forms of energy.'
11. What factors affect the stability of a body?
12. What is meant by the centre of gravity of an object?
13. Where is the centre of gravity of a uniform bar?
14. How is the stability of a body affected by the location of the centre of gravity?
15. What is the difference between a fixed and a movable pulley?
16. What determines the mechanical advantage of the wheel and axle?
17. How will you determine the centre of gravity of a uniform rectangular lamina?
18. How will you determine the centre of gravity of a uniform triangular lamina?
19. Describe a wheel and axle. What is its mechanical advantage ? If the wheel has a diameter of 50 cm and the axle has a diameter of 25 cm. What is the mechanical advantage?

3. Hydrostatics

Regions of the atmosphere- air pressure-barometer-application of fluid pressure.

3.1. Regions of the atmosphere

The earth is surrounded by an envelope of air called the atmosphere, which extends to a height of at least 960 kilometres. The total weight of the atmosphere is very large, and the pressure exerted on account of its weight is called atmospheric pressure. The lower atmosphere is divided into two layers, the troposphere and the stratosphere (Fig 3.1).

1. *Troposphere :* The troposphere extends to heights ranging from 16 km at the equator to 8 km at the poles. It is the region of rising, falling and swirling currents of clouds. Its chief constituents are nitrogen and oxygen in the proportion of 4 parts to 1 by volume, as well as carbon dioxide and water vapour. There are other gases in relatively small amounts and dust in variable quantity. In this layer, the temperature decreases with altitude.

2. *Stratosphere :* The stratosphere rises above the troposphere to an altitude of 64 km and contains one-fifth of the entire mass of air. Here the currents are mainly horizontal. It absorbs much of the harmful ultra-violet rays coming from the sun. The temperature remains constant in this layer. The ultra-violet radiations from the sun are absorbed by the ozone which is a special type of oxygen.

3. *Ionosphere :* Above the stratosphere is the ionosphere which extends from about 50 to 480 km. This region is most affected by the high frequency radiations coming from space. It consists of charged

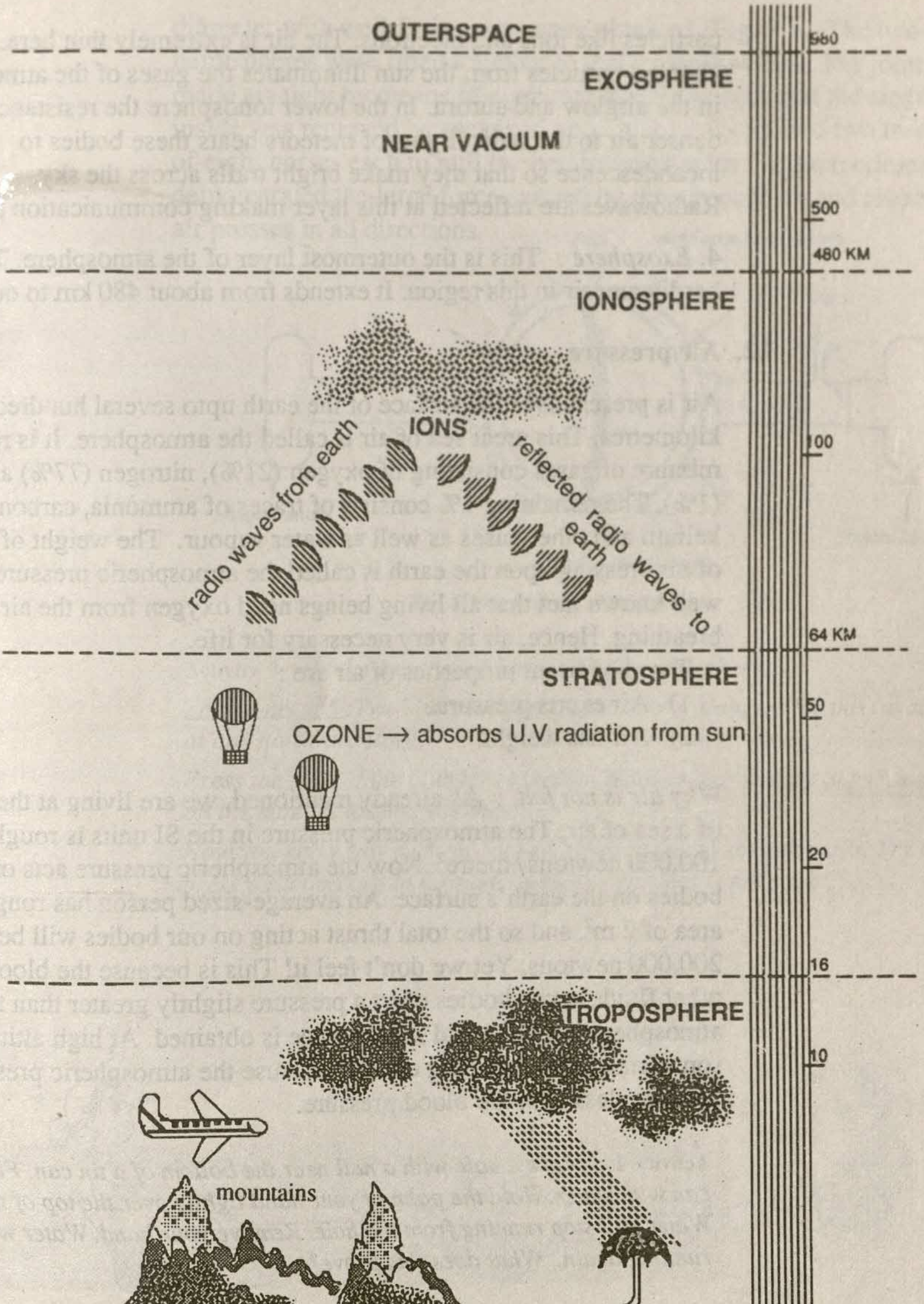


Fig 3.1 Regions of the atmosphere

particles like ions and electrons. The air is extremely thin here. The charged particles from the sun illuminates the gases of the atmosphere in the airglow and aurora. In the lower ionosphere the resistance of denser air to the swift flights of meteors heats these bodies to incandescence so that they make bright trails across the sky. Radiowaves are reflected at this layer making communication possible.

4. *Exosphere :* This is the outermost layer of the atmosphere. There is hardly any air in this region. It extends from about 480 km to outerspace.

3.2. Air pressure

Air is present over the surface of the earth upto several hundred kilometres. This great sea of air is called the atmosphere. It is really a mixture of gases consisting of oxygen (21%), nitrogen (77%) and argon (1%). The remaining 1% consists of traces of ammonia, carbon-dioxide, helium and other gases as well as water vapour. The weight of this sea of air pressing upon the earth is called the atmospheric pressure. It is a well known fact that all living beings need oxygen from the air for breathing. Hence, air is very necessary for life.

Two important properties of air are :

1) Air exerts pressure.
2) Air has weight.

Why air is not felt : As already mentioned, we are living at the bottom of a sea of air. The atmospheric pressure in the SI units is roughly 100,000 newtons / metre^2. Now the atmospheric pressure acts on all bodies on the earth's surface. An average-sized person has roughly an area of 2 m^2, and so the total thrust acting on our bodies will be about 200,000 newtons. Yet we don't feel it! This is because the blood and other fluids in our bodies exert a pressure slightly greater than the atmospheric pressure and so a balance is obtained. At high altitudes, sometimes, nose-bleeding occurs because the atmospheric pressure becomes less than the blood pressure.

Activity 1 : *Make a hole with a nail near the bottom of a tin can. Fill the can with water. Hold the palm of your hand tightly over the top of the can. Water will stop running from the hole. Remove your hand. Water will start running again. What does this prove?*

Magdeburg hemispheres : In 1654, Otto Von Guericke performed an experiment in Magdeburg, a town in Germany, to show the existence of atmospheric pressure. Two metal hemispheres of about 38 cm in diameter with well-fitting rims were obtained (Fig. 3.2). The two hemispheres were fitted together to make a hollow ball. The joint was made air-tight by means of a greased leather washer and the air from inside was removed by means of an air pump. It required two teams of eight horses each to pull the hemispheres apart. This experiment demonstrated the large force exerted by the atmosphere and also that air presses in all directions.

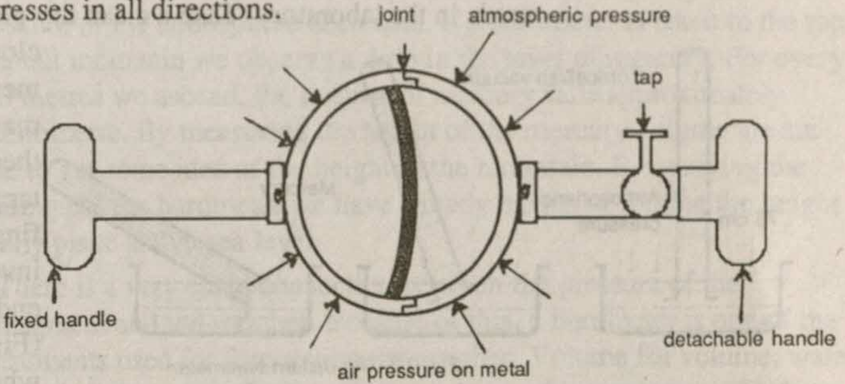


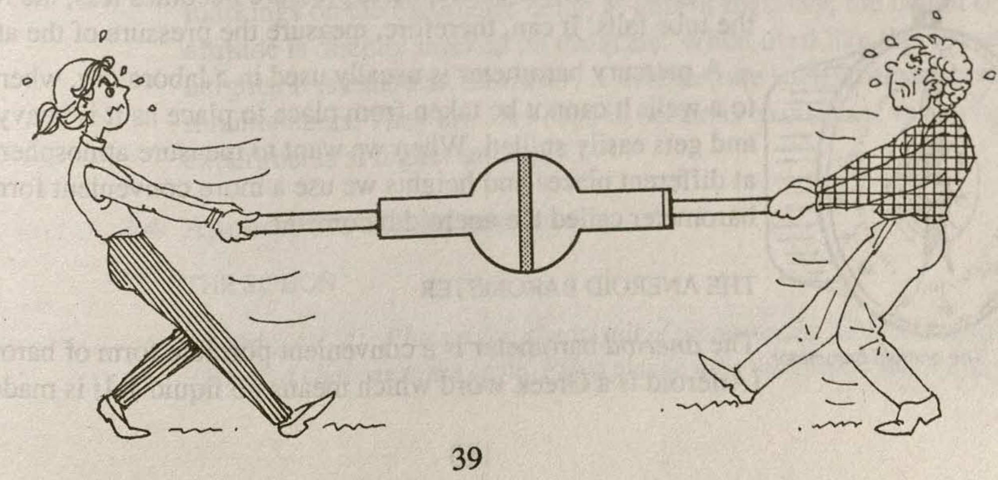
Fig. 3.2 Magdeburg's hemispheres

Activity 2 : *Make a model of Magdeburg's hemispheres.*

Things needed :Two sink plungers or plumber's plungers for this (available at any hardware store).

Press the cups of the plungers together. Now, two of you try to pull hard on the handles to separate them.

Now you know why suction-capped arrows stick to smooth walls. Try to press a suction cup to a rough surface. Why does it not stick ?



3.3 Barometer

The barometer is used to measure the atmospheric pressure at a place.

THE CISTERN BAROMETER

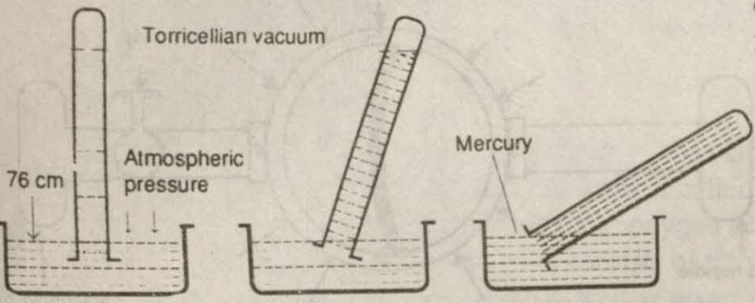


Fig. 3.3 The Cistern barometer

This was first designed by Toricelli in 1643. A simple barometer can be made in the laboratory. Take a clean dry glass tube about 1 m long, closed at one end and fill it with mercury. Any air bubbles that may be sticking to the sides of the tube may be removed by tapping the tube gently. Place a finger over the open end and, inverting the tube, place this end in a small dish of mercury (Fig 3.3). Remove your finger when the end of the tube is under the surface of the mercury in the dish. The mercury drops a few inches at the top of the tube leaving a space. The distance between the top of the mercury column and the surface of mercury in the dish is about 76 cm at sea level. Since the air from the tube was removed at the start, the space above the mercury in the tube cannot be air. It is a vacuum — a space containing nothing. If the tube is tilted to one side, the mercury fills the tube right to the top. The space appears again when the tube is held vertically. The atmospheric pressure acting on the surface of the mercury in the dish prevents the mercury in the tube from falling any further. The vacuum at the top of the tube is called the Torricellian vacuum after the man who discovered it.

When the atmospheric pressure becomes greater, the mercury in the tube goes up. If the atmospheric pressure becomes less, the mercury in the tube falls. It can, therefore, measure the pressure of the atmosphere.

A mercury barometer is usually used in a laboratory, where it is fixed to a wall. It cannot be taken from place to place as it is heavy, expensive and gets easily spilled. When we want to measure atmospheric pressure at different places and heights we use a more convenient form of barometer called the aneroid barometer.

THE ANEROID BAROMETER

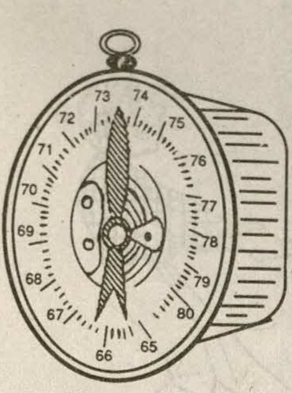


Fig. 3.4 The aneroid barometer

The *aneriod* barometer is a convenient portable form of barometer. (Aneroid is a Greek word which means no liquid.) It is made in such a small size that it can be carried in the pocket. Its general appearance is like a pocket watch.

Activity 3 : *Collect pictures of the aneroid barometer and find out more about the working of this barometer.*

Uses of a barometer : You already know that as we go higher, the pressure of the atmosphere decreases. If a barometer is taken to the top of a tall mountain we observe a drop in the level of mercury. For every 120 metres we ascend, the column of mercury falls approximately 1 centimetre. By measuring the height of the mercury column we are able to get some idea of the height of the mountain. By studying the readings of the barometer we have a ready means of finding the height of any place above sea level.

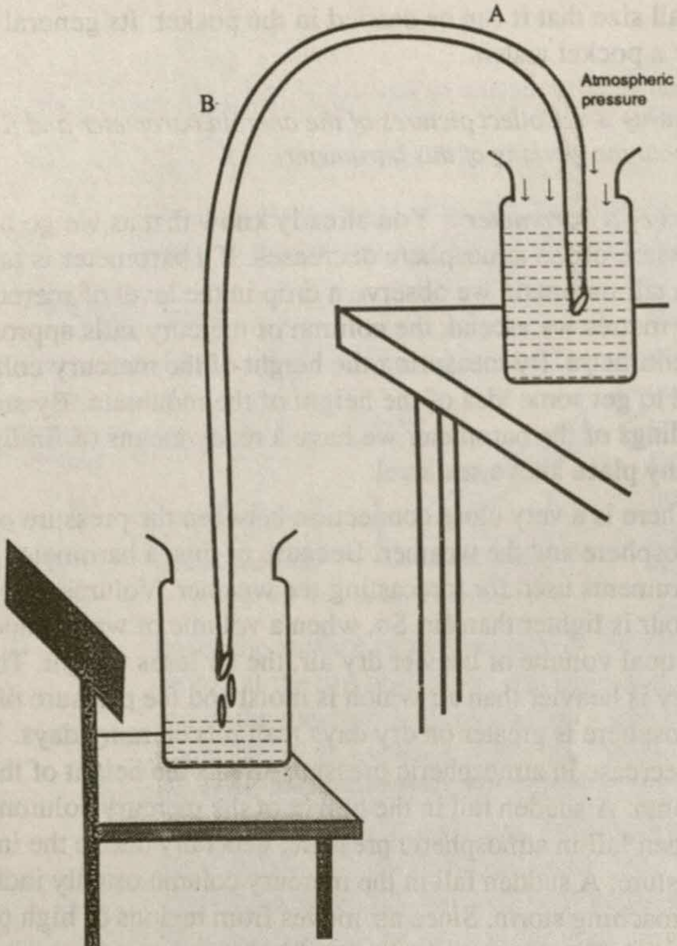
There is a very close connection between the pressure of the atmosphere and the weather. Because of this, a barometer is one of the instruments used for forecasting the weather. Volume for volume, water vapour is lighter than air. So, when a volume of water vapour displaces an equal volume of heavier dry air, the air loses weight. Thus, air which is dry is heavier than air which is moist and the pressure of the atmosphere is greater on dry days than it is on rainy days. This increase or decrease in atmospheric pressure affects the height of the mercury column. A sudden fall in the height of the mercury column means a sudden fall in atmospheric pressure, generally due to the increase of moisture. A sudden fall in the mercury column usually indicates an approaching storm. Since air moves from regions of high pressure to regions of low pressure, a study of barometric readings gives valuable information on the directions of winds.

Since atmospheric pressure varies with height, aneroid barometers are often used to measure height rather than pressure. Instead of the markings on the barometer being in cms of mercury, the height or altitude is directly marked on the scale. When used like this to measure heights, it is called an *altimeter*. Altimeters are used in aircrafts and by mountaineers. They are also used in balloons to conduct various experiments at higher attitudes.

3.4 Applications of fluid pressure

THE SIPHON

Activity 4 : *a) Place a jar almost full of water on the table and another jar on a chair near the table. Fill a plastic tube with water and closing*



both ends with your thumbs, place one end in the jar of water on the table and the other in the jar on the chair. Remove your thumbs from the ends. Note down what happens.

b) Now place both the jars on the table and repeat the experiment. Note down what happens.

c) Repeat the above experiments without filling the tube with water. Note down what happens.

Gravity causes water to flow from the tube from *B* downwards and reduces the pressure at *B*. Now the pressure of air at *A* is greater and water is forced into the tube and flows downwards. When the jars were at the same level there was no difference in pressure in both the jars. Besides, if there is no water in the tube there is no continuous flow of the water.

A siphon is a tube which uses pressure and gravity to transfer liquid from one vessel to another.

Uses of the siphon

1. It is used for easy transfer of a liquid from a larger vessel to a smaller vessel.
2. When a liquid contains impurities and dirt in the form of a sediment, the liquid at the top can be drained off using the siphon.
3. It is used in flush-out tanks.
4. It can be used to separate two immiscible liquids. The lighter liquid which floats on the top can be siphoned off.

TANTALUS CUP

In this cup a siphon is hidden inside the figure of a doll which is supposed to represent Tantalus (Fig 3.5). The story goes that Tantalus, son the Greek god Zeus, was cursed by his father with a never-ending thirst. He was made to stand in water which reached up to the level of his chin but flowed back whenever he tried to drink it.

The bend of the siphon is near the mouth, so that when the level of water in the cup reaches the bend it siphons out, leaving Tantalus thirsty.

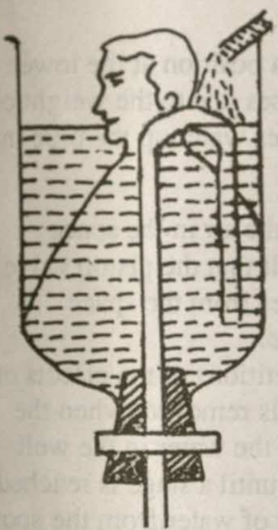


Fig. 3.5 Tantalus cup

THE LIFT PUMP

This pump, known sometimes as the suction or common pump, is used for drawing water from a well. It is the oldest type of pump and has been used for centuries — even before the time of Galileo.

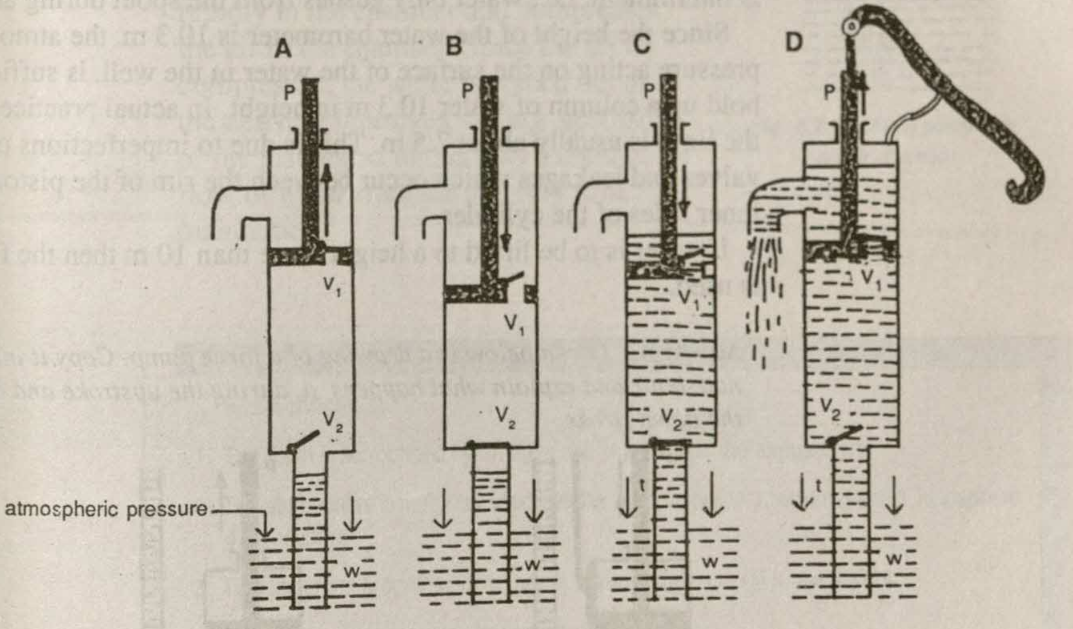


Fig. 3.6 The lift pump

The pump (Fig 3.6) consists of a cylinder which is connected by a tube to the well from which water is to be raised. Inside the cylinder is a piston which can be raised or lowered by working the pump handle. There is a valve at the point where the tube joins the cylinder, called the *foot valve.* Another valve, called the *piston valve*, is fitted in the piston. Both valves open upwards, i.e., away from the water in the well.

Working

1. *Upstroke* : When the piston is raised from a position at the lower end of the cylinder [Fig. 3.6 (a)], valve V_1 closes due to the weight of the air above it. The atmospheric pressure pushes water up the pipe into the cylinder by opening the valve V_2.

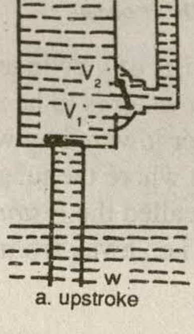
2. *Downstroke* : When the piston is lowered, the air in the space between the valves is compressed with the result that the piston valve opens and the foot valve closes. Air now escapes from the space between the two valves through the piston valve.

Further up-strokes of the piston result in repetitions of the effects of the first one until nearly all the air in the pump is removed, when the pressure of atmosphere acting on the surface of the water in the well forces more water up the tube into the cylinder until a stage is reached when water is forced out of the spout. The flow of water from the spout is intermittent, i.e., water only gushes from the spout during an upstroke.

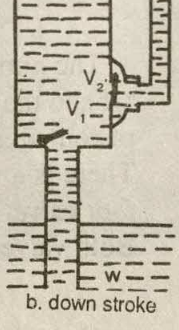
Since the height of the water barometer is 10.3 m, the atmospheric pressure acting on the surface of the water in the well, is sufficient to hold up a column of water 10.3 m in height. In actual practice, however, the limit is usually about 7.5 m. This is due to imperfections of the valves and leakages which occur between the rim of the piston and the inner sides of the cylinder.

If water is to be lifted to a height more than 10 m then the force pump is used.

Activity 4 : *Given below is a drawing of a force pump. Copy it into your note book and explain what happens a. during the upstroke and b. during the down stroke.*



a. upstroke



b. down stroke

THE FORCE PUMP

The force pump, like the lift pump, provides us with an intermittent flow of water. Its advantage over the lift pump is that it can raise water to any height depending on the strength of the machine and the force with which the piston is driven downward. In addition, the flow of water from the outlet pipe can be made continuous by having an air chamber attached to the outlet pipe. If this is done, then on each downstroke, water accumulates in the chamber. If the piston is rapidly worked, then during successive downstrokes water collects rapidly in the chamber and compresses the air in the chamber. Since the air is compressed, the water is forced out of the delivery tube even during upstrokes of the piston and in this way a continuous flow of water from the delivery tube is maintained.

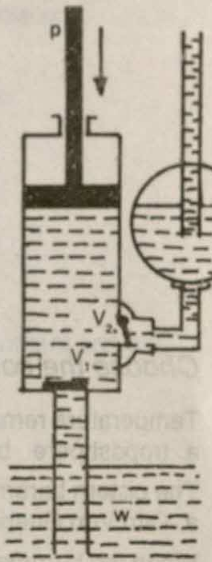


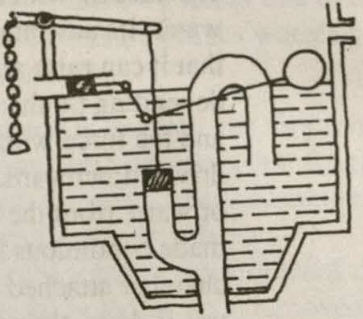
Fig. 3.7 The force pump with an air chamber

Basic concepts

1. The earth is surrounded by an envelope of air called the atmosphere.
2. The atmosphere is mainly divided into the 1. troposphere 2. stratosphere 3. ionosphere 4. exosphere.
3. Two important properties of air are (i) It exerts pressure (ii) It has weight.
4. The barometer measures atmospheric pressure.
5. The aneroid barometer is a "no liquid" barometer.
6. The aneroid barometer used to measure altitude is called an altimeter.
7. A siphon uses pressure and gravity to transfer liquid from one vessel to another.
8. A lift pump is used to draw water from a well or underground tank.
9. The force pump is used to lift water to a height of of more than 10 m.

Some investigatory projects/activities

A flush tank is shown in the diagram below. On what principle does it work ? Explain what happens when the chain is pulled.



REVISION

I. Choose the correct answer.

1. Temperature remains constant in the
   a. troposhpere. b. stratosphere. c. ionosphere. d. exosphere.
2. The cistern barometer was first designed by
   a. Otto Von Guericke. b. Fortin. c. Galileo. d. Toricelli.
3. When the barometer reading falls, it usually indicates
   a. an increase in air pressure. b. a rise in temperature.
   c. an approaching storm. d. none of the above.
4. Water rises in the cylinder of a lift pump when the piston is raised because
   a. water seeks its own level. b. it is pushed up due to atmospheric pressure.
   c. air pressure in the cylinder is reduced.

II. Fill in the blanks.

1. The layer of the atmosphere in contact with the earth is the ....
2. The chief constituents of the troposphere are ....,
   ...., ..., and ....
3. The layer in which the temperature remains constant is called the ....
4. The layer of the atmosphere which consists of charged particles like ions and electrons is called the ....
5. The outermost layer of the atmosphere is called the ....
6. Atmospheric pressure .... as we go from the plains to the hills.
7. The height of the mercury barometer is .... cms of mercury at sea level.
8. The space above the mercury in the barometer is called ....
9. The Magdeburg hemisphere experiment was performed by ....
10. The flush-out tank is based on the principle of ....
11. Aneroid barometer means a .... barometer.
12. An altimeter is a modification of a ....

III. *State whether true or false.*

1. The outer most layer of the atmosphere is called the ionosphere.
2. The stratosphere absorbs most of the harmful ultra-violet radiation from the sun.
3. The height of the barometer does not change if the tube is tilted.
4. If a barometer is taken to the top of a mountain the level of mercury rises.
5. The common pump is also known as the lift pump.
6. A siphon cannot work in vacuum.

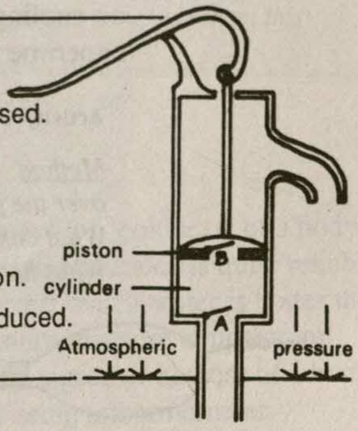
IV. *Answer the following questions.*

1. Give an account of the different layers of the atmosphere.
2. Describe the 'Magdeburg hemispheres' experiment. What does the experiment prove ?
3. Describe the cistern barometer. What are its uses ?
4. Describe the construction and working of the lift pump.
5. Describe the construction and working of the force pump.
6. Describe the action of a siphon. What are its uses ?

V. *Look at this diagram of a lift pump :*

1. *Now match the following :*

The result of raising the piston	from returning to the well.
Atmospheric pressure makes the water	is that the water is compressed.
Valve A allows the water	to pass the piston.
Valve A prevents the water	enter the cylinder.
The result of lowering the piston	to enter the cylinder.
Compression makes the water	from returning past the piston.
Valve B allows the water	is that the air pressure is reduced.
Valve B prevents the water	pass the piston.



2. *Match the following :*

1. Ionosphere	a. almost vacuum
2. Troposphere	b. charged particle
3. Stratosphere	c. clouds
4. Exosphere	d. Toricelli vacuum
	e. U.V.absorption

4. Heat

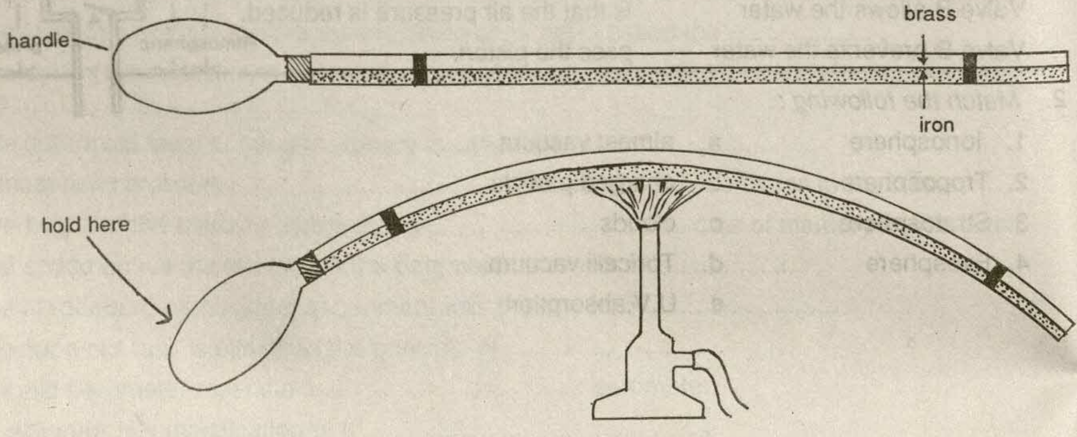
Thermal expansion - liquid thermometers - vapourisation - transfer of heat - conduction - convection - radiation - thermos flask - solar heat.

4.1. Thermal expansion

We have already learnt that substances expand on heating and contract on cooling. Do all substances expand equally on heating? The following experiment helps us to answer this question.

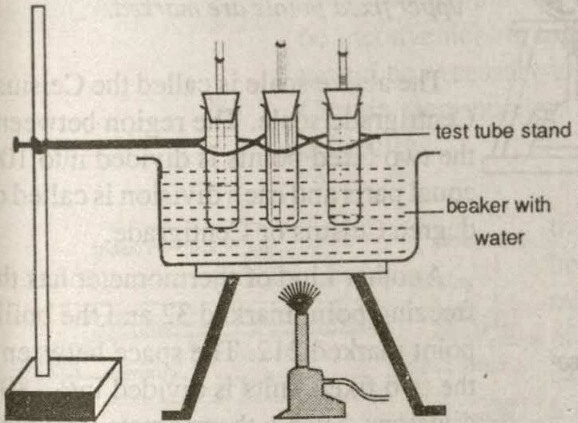
Activity 1 : *Things needed :- A bimetallic strip, a burner or spirit lamp.*

Method : Light the burner or the spirit lamp and hold the bimetallic strip over the flame. What happens ? Which metal expands more, iron or brass? What can you conclude from this experiment ? Allow the strip to cool. What happens?



We realise that different solids expand by different amount for the same rise of temperature. Can you think of any other instances from daily life to prove this fact?

What about liquids ? Do they expand differently on heating ? Do this experiment and find out.



Activity 2 : *Things needed : Three identical test tubes fitted with a one-holed stopper through which a narrow glass tube is inserted, some turpentine, methylated spirit and water. Put a few drops of blue ink into the water and ink into the spirit.*

Method : Fill the three test tubes with the three liquids. Adjust the levels in all the three tubes so that they are the same. Mark these levels with gummed paper. Fix the test tubes in a stand and lower them into a beaker of water. Heat the water with a spirit lamp or burner, and keep your eyes fixed on the liquid levels in the three tubes.

What do you notice? Are the levels the same? What can you conclude from this experiment?

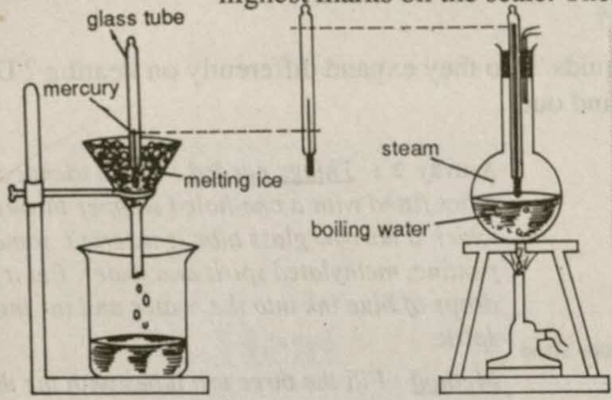
4.2 Liquid thermometers

Temperature is the measure of the 'hotness' or 'coldness' of a body. It tells us how hot or cold a body is. Our sense of touch is quite reliable for comparing temperature, i.e., we can tell which water is hotter than the other by just touching it. But we cannot measure temperature accurately using our sense of touch. The degree of hotness of a body, i.e., its temperature, can be determined using a thermometer.

The working of a thermometer is based on the principle that substances expand on heating and contract on cooling. The thermometer widely used today is the mercury thermometer. For measuring very low temperatures, alcohol is used, as mercury freezes at -39°C.

THE MERCURY THERMOMETER

It consists of a thick-walled glass tube of uniform bore, at one end of which is a thin-walled bulb of cylinderical shape. The bulb and a portion of the stem are filled with mercury. A graduated scale is engraved on the stem. Two fixed temperatures are chosen as the lowest and highest marks on the scale. These are called the *fixed points* on the scale.



Activity 3 : *The diagram alongside shows how the fixed points are marked on a mercury thermometer. Study the diagram carefully and then write a paragraph each about how the lower and upper fixed points are marked.*

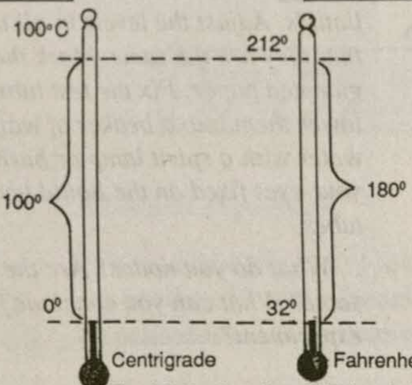


Fig. 4.1 Centigrade and Fahrenheit scales

The above scale is called the Celsius or Centrigrade scale. The region between the two fixed points is divided into 100 equal parts and each division is called one degree Celsuis or Centigrade.

Another kind of thermometer has the freezing point marked 32 and the boiling point marked 212. The space between the two fixed units is divided into 180 divisions. Such a thermometer is called a *Fahrenheit thermometer*. Each division on this scale is called a degree Fahrenheit.

THE CLINICAL THERMOMETER

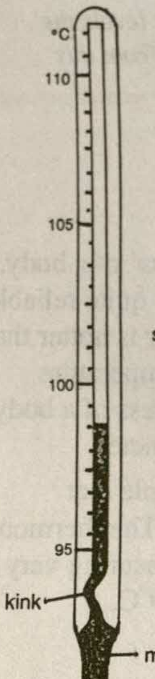


Fig. 4.2 Clinical thermometer

The thermometer with which we are all familiar is the one used by the doctor to take our temperature. It is called the clinical thermometer (Fig. 4.2). Since the doctor only requires it for testing the temperature of the human body, the scale is graduated between 95°F and 110°F, which is as cold or hot as a human being can be. Each degree is divided into five equal parts because even small variations in the temperature of a patient are of great importance. The bore of the thermometer is exceptionally fine and has a kink in it. When the mercury is heated, the great force of its expansion pushes it past the kink. As the thermometer is removed from the heat of the patient's body and comes in contact with the cooler air, the mercury contracts. The portion of the mercury below the kink retreats into the bulb while the portion of the mercury above the kink stays where it is, as it cannot squeeze its way back through the kink. The thermometer may now be kept until the arrival of the doctor. Once the reading has been taken, the thermometer is re-set by bringing the mercury in the bore back to the bulb with a jerk.

A person in good health has a temperature of 98.6°F and there is a mark on the thermometer at this point. A temperature of over 100 F indicates fever and if the thermometer registers over 105°F, it means the patient is dangerously ill.

MAXIMUM AND MINIMUM THERMOMETERS

In meteorological observations, it is necessary to record the highest and lowest temperature of the air for a period of every 24 hours. It would be inconvenient to use an ordinary thermometer for such a purpose as it would be necessary to observe it continually which is impracticable. Certain thermometers have been specially designed to overcome this difficulty.

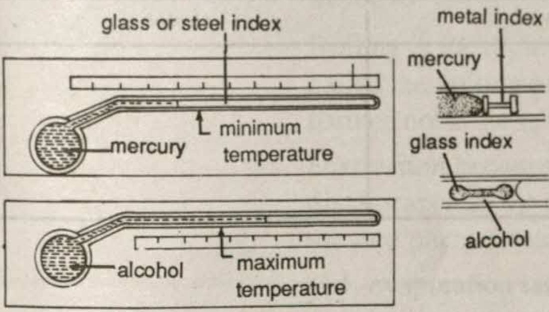


Fig. 4.3 Maximum and minimum thermometers

The maximum thermometer is merely an ordinary thermometer fixed in a horizontal position to a board. In the bore of the thermometer, beyond the mercury column, is a dumb-bell-shaped index made of steel. When the temperature rises, the mercury expands and pushes the index forward. When the temperature falls, the mercury contracts leaving the index behind. The end of the index nearest the mercury gives the maximum temperature reached during a certain period of time. The thermometer is re-set by sliding the index back to the end of the mercury column with a magnet.

The minimum thermometer contains alcohol and is fixed in a horizontal position to a board. The dumb-bell-shaped index is made of black glass and is immersed in the alcohol column. When the temperature falls, the alcohol contracts and the surface of the alcohol column drags the index back towards the bulb. This is due to the force of surface tension about which you will learn later. When the temperature rises, the alcohol expands and flows past the index leaving it behind. The end of the index away from the bulb indicates the minimum temperature reached during a certain period of time. The thermometer is re-set by holding it at a slant with the bulb uppermost, thus allowing the index to slide along in the alcohol until it is stopped by the surface of the alcohol.

THERMOMETRIC LIQUIDS

Mercury is the most commonly used liquid in thermometers. It is silver coloured, opaque and can be easily seen in the stem. It does not wet glass and so the readings are accurate. Mercury is a good conductor of heat and soon assumes the temperature of its surroundings.

Mercury freezes (becomes solid) at –39°C and hence cannot be used below this temperature. Therefore for measuring very low temperatures alcohol thermometers are used. Alcohol freezes at –117°C. Alcohol also expands much more than mercury does which makes it a more sensitive indicator. However alcohol wets glass and cannot be used for high temperatures as its boiling point is low. It is also a bad conductor of heat. Alcohol is colourless and is usually coloured red to make the reading easier.

Activity 4 : *After reading the above paragraph, list five differences between mercury and alcohol as thermometeric liquids.*

S.N.	Mercury	Alcohol
1.		
2.		
3.		
4.		
5.		

4.3 Vaporisation

EVAPORATION

The change of a substance from the liquid to the vapour state is called *evaporation.* This change of the liquid to vapour is gradual and takes place only at the surface of the liquid.

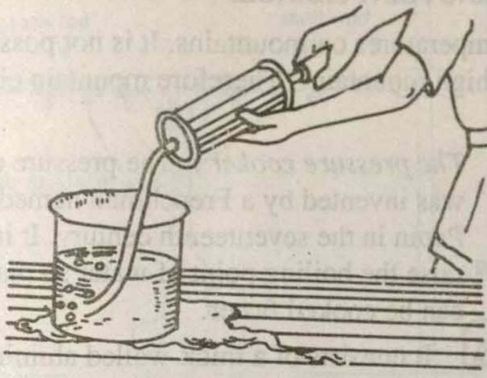
A liquid evaporates quickly if it is (1) at a high temperature, (2) the atmosphere is dry, (3) the area of the exposed surface is large, and (4) there is a breeze to assist in the removal of the vapour as it is formed.

Some liquids such as ether and methylated spirit evaporate more readily than other liquids such as water and coconut oil.

COOLING EFFECT OF EVAPORATION

During evaporation, heat is taken from the remaining portion of the liquid and from the substance in contact with the liquid.

Activity 5 : *Pour some water on a table and put an empty beaker on it. Next, pour some ether in the beaker and blow a stream of air through the ether with the help of a football pump connected to a rubber tube as (shown in the figure).*



After the ether has evaporated, try to remove the beaker from the table. You will find that the beaker is now stuck to the table.

While the ether evaporated, it took the heat away from the bottom of the beaker to such an extent that the water beneath the beaker froze.

Activity 6 : *Questions to think about : Why is eau-de-cologne spread on the forehead of a person who has fever ? Why do you feel cool when you rub scent on your skin? Why do you feel cool if you stand under a fan after exercising?*

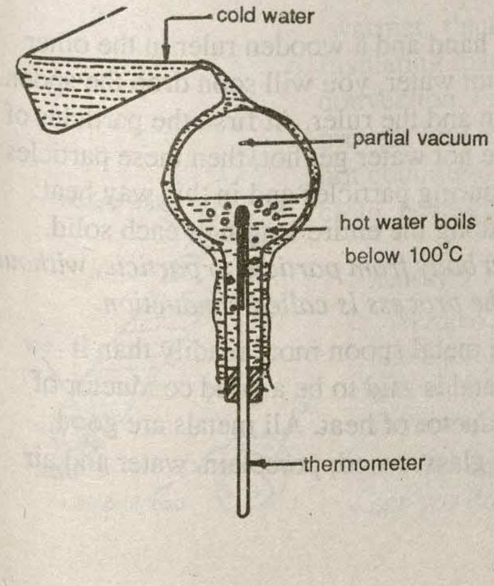
BOILING

Boiling is the rapid conversion of a liquid to vapour at a temperature called the boiling point of the liquid. Unlike evaporation, the vapour is formed not at the surface of the liquid but throughout the body of the liquid.

Distinction between evaporation and boiling : In both cases, water disappears into the air as steam or water vapour. The difference between the two phenomena are :

1. evaporation takes place only at the surface of the liquid, whereas in boiling, steam also escapes from the interior of the liquid.
2. evaporation takes place at any temperature, whereas boiling takes place at a fixed temperature.
3. the temperature remains constant during boiling whereas during evaporation, the temperature may vary.

Boiling point and pressure : Reduced pressure lowers the boiling point of water. A reduction of 3 cm pressure lowers the boiling point by about 1°C. Increased pressure raises the boiling point of water.



Activity 7 : *Half fill a thick-walled, round-bottomed flask with water. Boil the water until all the air is driven out of the flask. Now remove the flame and fit the flask with a rubber stopper and a thermometer. Clamp it upside down.*

When boiling stops, pour cold water over the flask. The cold water condenses some of the steam in the flask. The pressure inside is therefore lowered. The water inside begins to boil again even though its temperature is below 100°.

APPLICATIONS OF BOILING POINT CHANGES

Water boils at lower temperatures on mountains. It is not possible to cook food properly on high mountains. Therefore mountain climbers use pressure cookers.

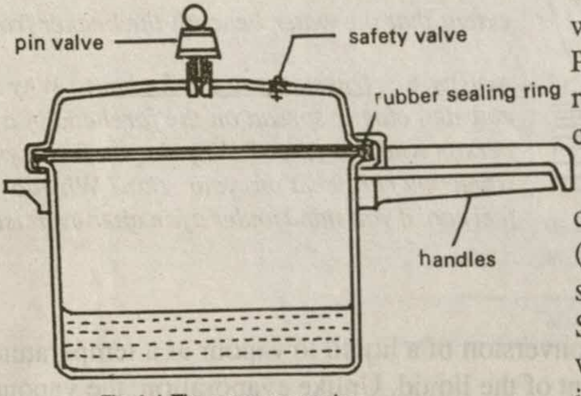


Fig 4.4 The pressure cooker

The pressure cooker : The pressure cooker was invented by a Frenchman named Denys Papin in the seventeenth century. It is used to raise the boiling point of water so that food can be cooked faster.

It consists of a thick-walled aluminium container fitted with a lid having a sealing ring (Fig. 4.4) to make it airtight. The pressure of steam inside raises the boiling point of water. Steam is allowed to escape through a pin valve which can be set to whistle when the pressure inside rises above the safe valve. Excess pressure ranging from one-third to one atmosphere can be obtained. The pressure cooker enables us to cook food at temperatures upto 120°C, saving time and fuel.

4.4 Transfer of heat

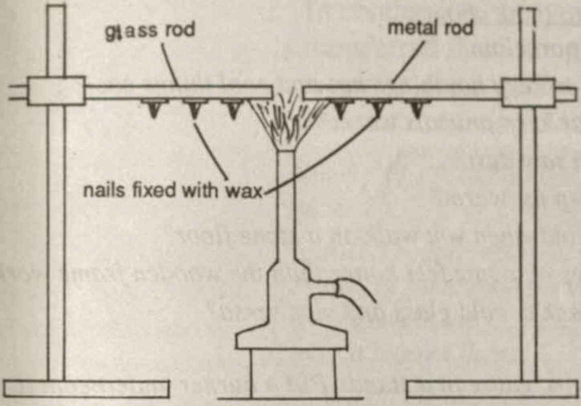
TRANSMISSION OF HEAT

Heat is transferred from one body to another by three different processes — *conduction*, *convection* and *radiation.*

CONDUCTION

If you take a metal spoon in one hand and a wooden ruler in the other and plunge their ends into very hot water, you will soon drop the spoon. Heat travels along both the spoon and the ruler. At first, the particles of the solid that are immersed in the hot water get hot, then these particles communicate heat to the neighbouring particles and in this way heat travels from particle to particle along the entire length of each solid. *When heat is transmitted along a body from particle to particle, without any movement of the particles, the process is called conduction.*

Because heat travels along the metal spoon more readily than it does along the wooden ruler, metal is said to be a good conductor of heat whereas wood is a bad conductor of heat. All metals are good conductors of heat. Wool, stone, glass, wood, porcelain, water and air are all bad conductors of heat.

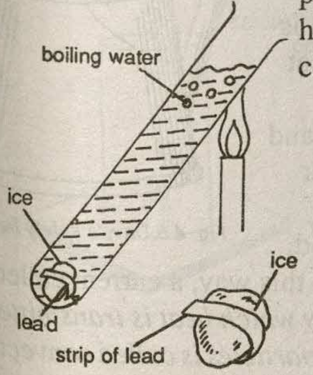


Activity 8 : *Take a glass rod and a metal rod of about the same thickness — you can choose a metal knitting needle having the same length and thickness as the glass rod. Fix some tack nails near one end of each rod with a few drops of candle wax. Now clamp them in a stand and heat them as shown.*

Which nails fall off first — the ones on the glass rod or on the metal rod ? Which nails take longer to fall off — the ones near the hot end or farther off ? What can we conclude from this experiment ?

Uses of good and bad conductors

1. Copper is used for making kettles, cooking vessels, boilers and boiler-tubes. A soldering iron is made of copper.
2. Aluminium is used for cooking vessels, motor-car engines, pistons and cylinders. It has a low density and it is a better conductor than steel. These engines weigh less and do not become too hot when working.
3. Refrigerators and ice-boxes have an air-space between double walls. Air is a good insulator. Cork or other porous material is used to stop convection currents in the air.
4. Blocks of ice are usually covered with cloth, paper or sawdust when being stored. The air-spaces in the materials reduce conduction from the air.
5. Clothes are poor conductors. Wool is a better insulator than cotton because it contains more air spaces. Therefore, woollen clothes are 'warmer' than cotton clothes.
6. Insulating material is used to reduce loss of heat by conduction and convection. Fibre-glass is often used under the roofs of buildings to prevent loss of heat (in cold countries) and to prevent heat gain (in hot countries). Hot water storage tanks and pipes are often lined with cloth, fibre-glass or asbestos wool.



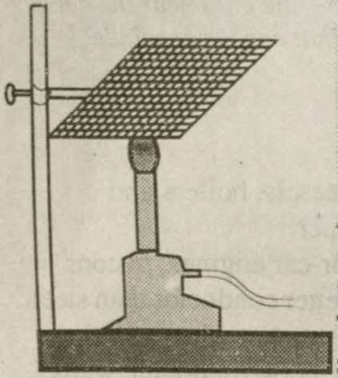
Activity 9 : *Experiment to show that water is a bad conductor of heat.*

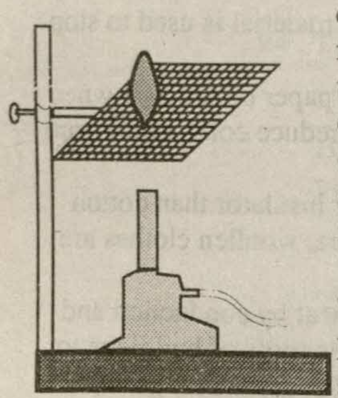
Wrap a strip of lead or a wire gauze round a piece of ice and put it into a test tube as shown in the figure. Fill three-fourths of the test-tube with water. Now hold the testtube at an incline and heat the surface of the water with a bunsen flame as shown.

What do you notice? Does the ice melt? Why? What conclusion can you draw from this?

Activity 10 : *Questions to think about :*
Why are cups made of porcelain?
Why is thermocol used to keep hot things hot and cool things cool?
How do feathers and fur keep animals warm?
Why is ice preserved in saw dust?
How does a blanket keep us warm?
Why do your feet feel cold when you walk on a stone floor?
Why do the iron railings of a gate feel hotter than the wooden frame work?
Why does hot water crack a cold glass and vice versa?

Activity 11 : *Clamp a wire gauze in a stand. Put a burner underneath it. Does the flame come through the gauze ? Why ? Now extinguish the burner and again light it by holding the lit match stick above the wire gauze. What do you find ? Why ?*





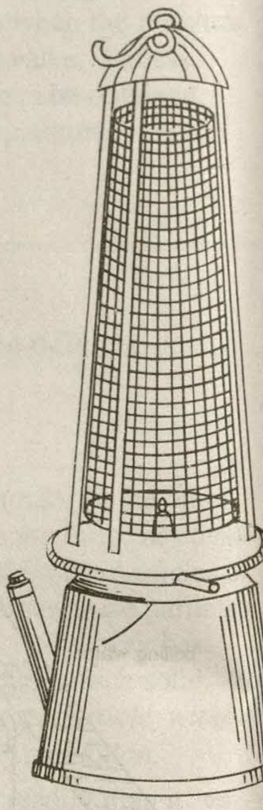


Fig. 4.5 Davy's safety lamp

Davy's safety lamp : Davy's safety lamp (Fig.4.5) used by miners is an application of the principle tested in the above experiment. The lamp consists of an ordinary oil lamp surrounded by a wire gauze. Owing to the conducting power of the gauze, the heat of the flame is conducted away rapidly and so the temperature outside the lamp is never high enough to bring about the combustion of any explosive gases that may be present in the mine. Such gases which pass through the gauze into the lamp are burnt within.

CONVECTION

Liquids and gases are bad conductors of heat and so heat is hardly transmitted through their masses by conduction. When a liquid or gas is heated, the portions nearest the source of heat expand, become less dense and rise. The particles in the portions that rise are heated and take their heat with them. The colder, denser portions from above now fall and take their place. When these portions in turn are heated, they expand, become less dense and rise. In this way, a current called a convection current is set up. *This process by which heat is transmitted i liquids and gases by the actual movement of particles is called convectio*

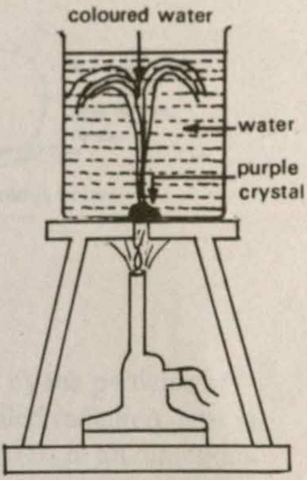
In conduction, the particles don't leave their places but heat energy is transferred from one particle to another by vibrations. While in convection, the particles of the medium carry the heat energy by movement from one place to another.

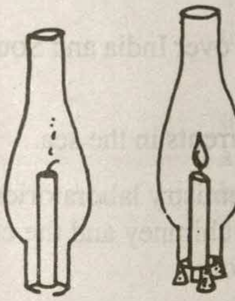
Activity 12 : *To set up convection currents in water :*

Fill a beaker with water and drop one crystal of potassium permanganate in the water (as shown in the figure). Heat the beaker gently over a bunsen flame.

Watch the movement of the coloured water in the beaker. You will observe the convection currents in the water.

What do you observe ? Draw the diagram again and mark the direction of motion of the particles with arrow heads.





Activity 13 : *To set up convection currents in gases :*

Place a lighted candle on the table and put a glass chimney around it. The flame soon goes out.

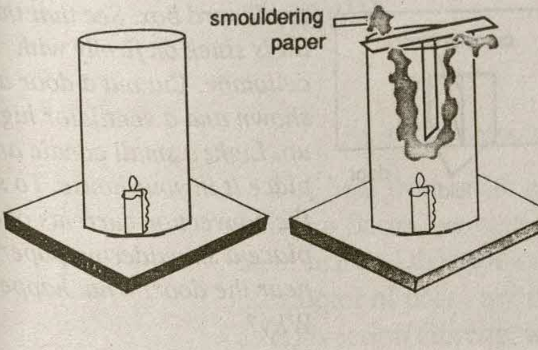
Repeat this experiment with a slight change. Place the chimney on three corks so that it is well off the table. The flame now burns brightly. Why?

Set fire to a piece of paper, and then blow it out so that it makes some smoke. Hold the paper below the chimney and note the direction taken by the smoke. In this way you will be able to follow the direction of the moving air that flows around the burning candle.

Draw the path taken by the smoke.

Activity 14 : *Light a short candle and stick it with wax on a piece of cloth. Place a tall glass cylinder over the candle. Press it down hard so that no air can enter at the bottom. What happens to the flame ?*

Light the candle and again place the cylinder over it. Place a T-shaped piece of metal as shown in the figure. Does the flame continue to burn? Set fire to a piece of paper and then blow it out so that it produces some smoke. Place this smouldering paper at one side of the T-shaped piece and note the convection currents. Remove the T -piece. What happens to the flame ? Why?



CONVECTION CURRENTS IN EVERYDAY LIFE

1. *Chimneys :* Smoke and gases from fires in houses and factories ris up chimneys, and the flow is a convection current. Gases rise up a tall chimney faster than up a short one. The current of air through the fire is due to the difference of pressure between the cold air outside and the hot gases in the chimney. High chimneys have a greater pressure difference.

2. *Ventilation :* The air we breathe out is damp, warm, and less dense than ordinary air. It rises and can escape through openings near the roo Houses and theatres have openings near their ceilings. In some rooms, fans blow out the warmer air near the ceiling.

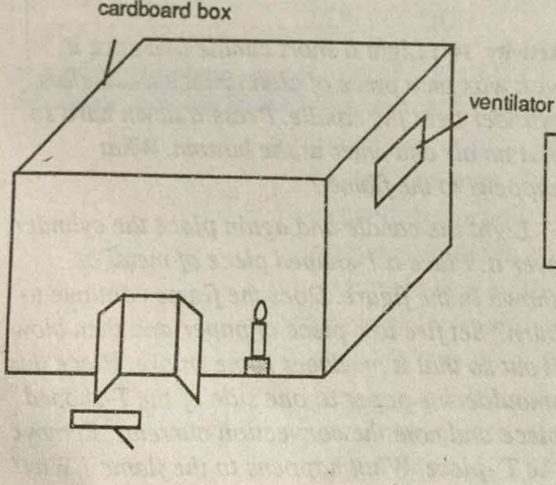
3. *Winds :* Winds are convection currents. Some parts of the earth's surface are hotter than others. The warm air rises over the hot surface, and cooler, denser air takes its place. Trade winds are caused when hot air near the equator rises and cooler air from the north and south takes its place.

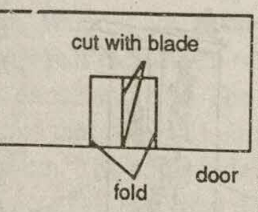
4. *Monsoon winds :* These winds which blow over India and South-Eas Asia are land and sea winds on a large scale.

5. *Ocean currents :* These are convection currents in the sea.

6. *A fume cupboard :* Fume cupboards in chemistry laboratories have a chimney. Hot gases from burners rise in the chimney and the current of air sucks chemical fumes out of the laboratory.

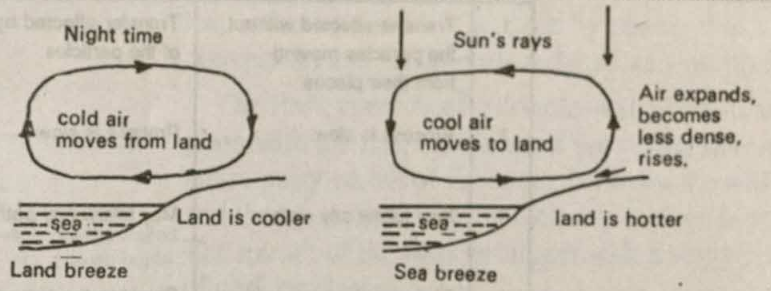
7. *Motor-car cooling system :* Car radiators cool water heated by the engine.





Activity 15 : *To show how ventilators in homes work make a cardboard house using a cardboard box. See that the lid is stuck on firmly with cellotape. Cut out a door as shown and a ventilator higher up. Light a small candle and place it in your house. To see the convection currents of air, place a smouldering paper near the door. What happens? Why?*

Activity 16 : *Explain the following diagram on the basis of convection currents.*



Land breeze
Sea breeze

RADIATION

In conduction and convection, heat is transmitted by the particles of matter. In the third mode of heat transmission, called radiation, heat is transmitted from one body to another in straight lines, in all directions and at a very great speed without the aid of matter and without heating the medium through which it passes.

Heat is transmitted from the sun to the earth by radiation. We say that the sun radiates heat and this heat is called *radiant heat*. You have already learnt about the regions of the atmosphere. You know that between the exosphere and the sun, a vacuum exists. Hence the sun's heat energy passes through this vacuum (no medium) and reaches us.

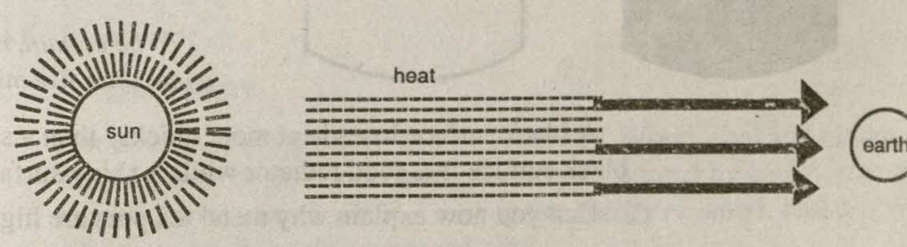


Fig. 4.6 The sun radiates heat to the earth

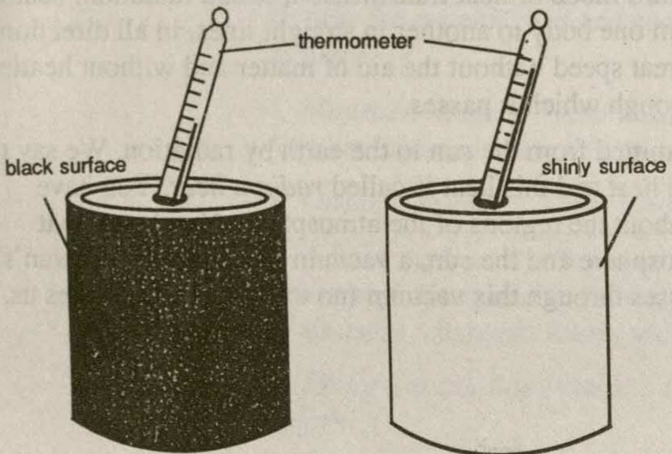
The heat from a fire reaches us by radiation. If we hold a thermometer below a flame, we note that the temperature rises. The heat could not have reached the bulb of the thermometer by conduction, as air is a poor conductor of heat ; nor could it have reached the bulb by convection, as convection currents would carry the heat upwards. It is evident therefore that the bulb has become heated by radiation.

Distinction between the three modes of transfer of heat.

	Conduction	*Convection*	*Radiation*
1.	Transfer effected without the particles moving from their places	Transfer effected by motion of the particles	No medium is necessary for transfer
2.	Process is slow	Process is slow	Heat radiations travels wi the speed of light.
3.	May follow any path	May follow any path	Travels only in straight lines
4.	Changes the temperature of the medium	Changes the temperature of the medium	Passes through a mediur without directly altering it temperature.

Activity 17 : *Take two tins with tight fitting lids and make holes in the lids so as to hold thermometers. Remove any label the tins may have. Paint the surface of one tin with black paint and leave the other shiny. Pour equal quantities of boiling water into the two tins at the same time and note the temperatures on the two thermometers. After five minutes note the temperature again. What do you find? Are they equal? Which one is less?*

To be certain, note the temperatures again after five minutes.



A black surface loses heat more quickly than a shiny surface, i.e., a black surface is a good radiator while a shiny surface is a poor radiato

Can you now explain why metal tea pots are highly polished?

Activity 18 : *Take the two tins like the one in activity 17. Leave the black one as it is and paint the shiny one white. Fill them both with equal amounts of cold water at the same temperature. Place them both in the sun and note their temperatures after 15 minutes.*

What do you notice about the temperature in the two tins ?

A black surface absorbs much more radiant heat than a white surfac In the light of the above experiment, would you prefer to wear light or dark garments in a. summer? b. winter?

4.5 The Thermos flask

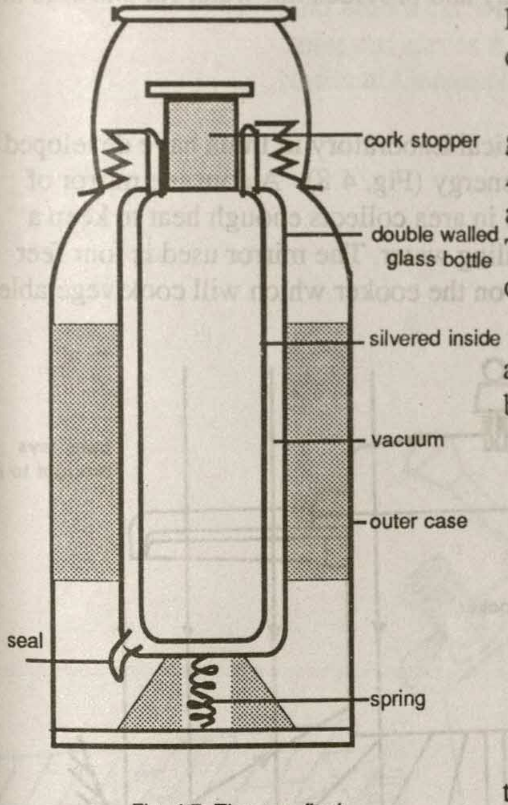


Fig. 4.7 Thermos flask

This flask is used to keep hot liquids hot and cold liquids cold. It is constructed in such a way that heat lost or heat gained by the flask by conduction, convection and radiation is reduced to a minimum.

The flask consists of a double-walled bottle of thin glass with the inner surfaces of the walls, silvered . Air is pumped out of the space between the walls, and the opening through which this is done is sealed. The mouth of the flask is closed with a stopper made of cork or plastic.

The glass bottle is placed in a metal or plastic case and is supported on corks on the sides and at the bottom.

1. Heat loss due to *conduction* is prevented because
   (i) glass and cork are poor conductors of heat, and
   (ii) conduction requires a medium and so conduction can not take place in vacuum.
2. the stopper and the absence of air (vacuum) prevent heat loss due to *convection*.
3. the highly polished silver walls prevent heat loss due to *radiation*.

The substance in the flask therefore retains its temperature for a long time.

4.6 Solar heat

SOLAR ENERGY

The source of much of our energy is the sun. Wood, coal and oil are our main sources of energy. In fact, the energy obtained by plants from the sun has been stored in these. In using the energy of wood, coal and oil, we are using the sun's energy indirectly.

The above mentioned sources of energy are not inexhaustible, i.e., with the rate at which the population on the earth is growing, there will come a day when the energy consumption for our needs will far exceed its availability. Man has constantly been in search of new sources of energy. Atomic or nuclear energy does provide us with a lot of energy but controlling it is quite difficult and frightening. Recently people have been successful in capturing the energy from the sun.

When we use the sun's energy directly, it is called *solar energy*. In many parts of the USA water heaters which runs on solar power are used.

The simplest example is a blackened cylindrical tank which absorbs heat from the sun during the day and provides hot water for showers in the evening.

SOLAR COOKER

Scientists of the National Physical Laboratory in India have developed a pressure cooker using solar energy (Fig. 4.8). A concave mirror of about a third of a square metre in area collects enough heat to keep a stove at the temperature of boiling water. The mirror used is four feet in diameter. This focuses heat on the cooker which will cook vegetables in 10 to 15 minutes.

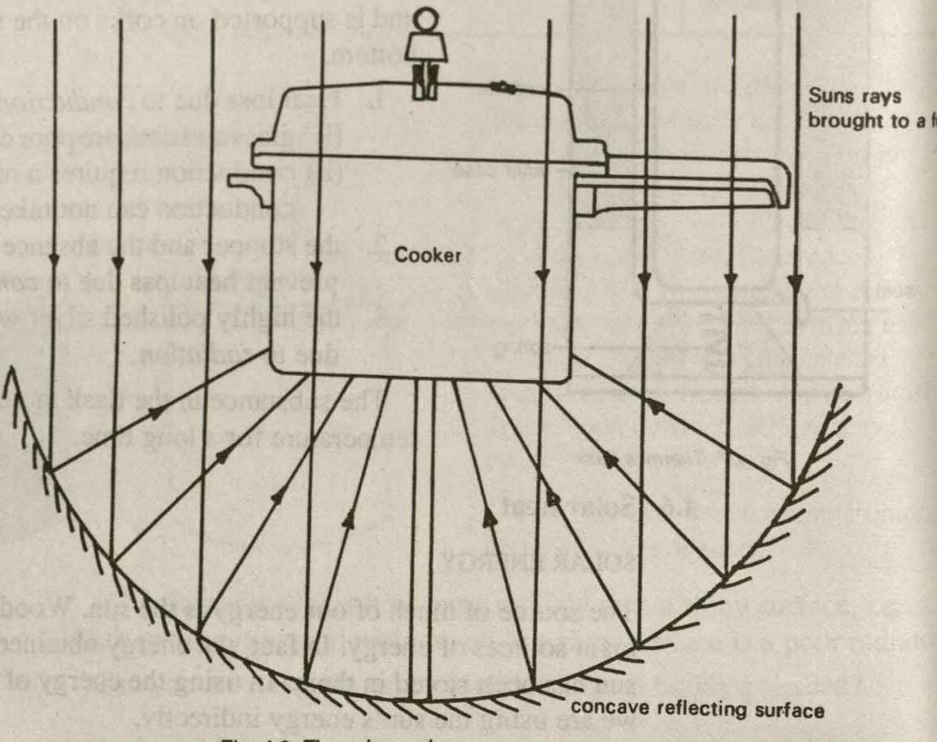


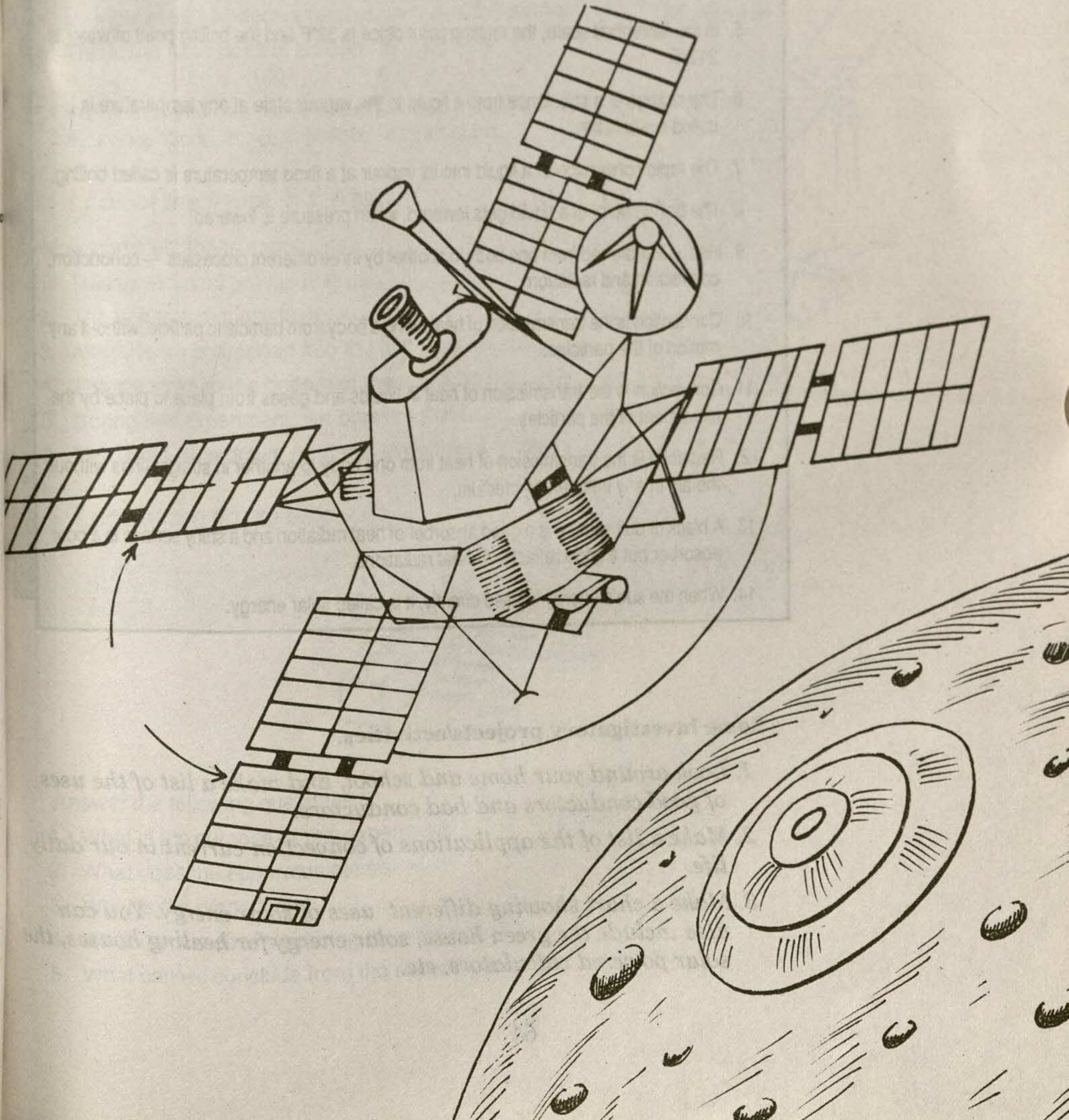
Fig. 4.8 The solar cooker

Solar cells are photocells in which solar energy is directly converted into electrical energy. A number of solar cells are grouped together to form a *solar panel*. These cells produce enough power to operate the various instruments in space-crafts.

About 1800 cells fitted to the Indian satellite Aryabhatta were able to provide a power of about 46 watts.

Solar collectors reflect the sun's rays on to a central spot where the heat is used to obtain electricity.

A few years back Larry Perkins along with his brother Gary designed and built a car which runs on solar power. They were able to drive this solar car across Australia. You may see pictures of this car in the National Geographic magazine, Nov'83 issue.



Basic concepts

1. On heating, different substances expand by different amounts.
2. Temperature is the degree of hotness of a body.
3. Liquid thermometers are based on the principle that liquids expand on heating and contract on cooling.
4. In the Centrigrade or Celsius scale, the meting point of ice is 0°C and the boiling point of water is 100°C.
5. In the fahrenheit scale, the melting point of ice is 32°F and the boiling point of water is 212°F.
6. The change of a substance from a liquid to the vapour state at any temperature is called evaporation.
7. The rapid conversion of a liquid into its vapour at a fixed temperature is called boiling.
8. The boiling point of a liquid gets lowered, when pressure is lowered.
9. Heat is transferred from one body to another by three different processes — conduction, convection and radiation .
10. Conduction is the transmission of heat along a body from particle to particle, without any motion of the particles.
11. Convection is the transmission of heat in liquids and gases from place to place by the movement of the particles.
12. Radiation is the transmission of heat from one body to another in straight lines without the aid of any intervening medium.
13. A black or dull surface is a good absorber of heat radiation and a shiny surface is a poor absorber but a good reflector of heat radiations.
14. When the sun's energy is used directly, it is called solar energy.

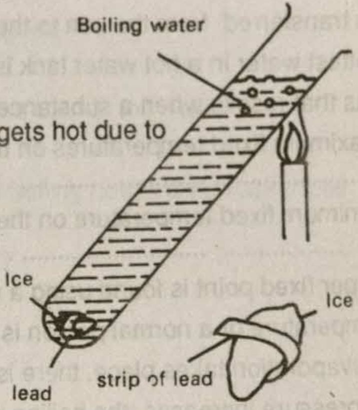
Some investigatory projects/activities.

1. *Look around your home and school, and make a list of the uses of good conductors and bad conductors.*
2. *Make a list of the applications of convection current in our daily life.*
3. *Make a chart showing different uses of solar energy. You can also include the green house, solar energy for heating houses, the solar powered calculators, etc.*

REVISION

I. Choose the correct answer

1. Liquid thermometers are based on
   a. conduction. b. convection. c. radiation. d. expansion of substances.
2. Evaporation takes place
   a. at a constant temperature. b. only when a liquid is heated. c. at all temperatures.
3. When the pressure increases, the boiling point of a liquid
   a. increases. b. decreases. c. remains the same.
4. The lower fixed point in a Fahrenheit scale is
   a. 32°. b. 0°. c. 180°.
5. When one end of a metal rod is heated, the other ends gets hot due to
   a. conduction. b. convection. c. radiation.

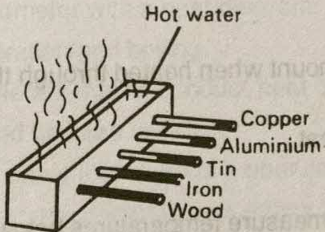


II. Look at the figure in the text

Now complete these sentences

1. This experiment proves that ....
2. The apparatus consists of ....
3. After the ice is dropped into the test tube ....
4. The ice sinks to the bottom of the test tube because... .
5. During this experiment, we observe that ....
6. The conclusion drawn from this experiment is that ....

III Look at the figure below



Answer the following questions :

1. What is the purpose of this experiment ?
2. What does the apparatus consist of ?
3. What is the procedure ?
4. What can we observe during the experiment ?
5. What can we conclude from the experiment ?

6. What property of copper does this experiment show ?
7. Why do cooking pots often have wooden handles ?

IV *Fill in the blanks.*

1. A thermometer measures the ....
2. The two thermometer scales most used are the .... and the ....
3. On a centigrade thermometer, the freezing point of water is .... degrees and the boiling point is .... degrees.
4. Heat is transferred from the sun to the earth by ....
5. The hottest water in a hot water tank is found in the .... part of the tank.
6. The gas that results when a substance evaporates is called a ....
7. The maximum fixed temperatures on the thermometer scale is called the ....
8. The minimum fixed temperature on the scale of the thermometer is called the ....
9. The upper fixed point is found using a vessel called a ....
10. The temperature of a normal person is ....
11. When evaporation takes place, there is a .... in temperature.
12. As the pressure increases, the boiling point of a liquid ....
13. The heat from the sun reaches us by the process of ....
14. A bad conductor of heat is called an.................................. .
15. A black surface is a good emilter and a good ....of heat.
16. A shiny surface is a .... absorber of heat radiations.

V *State whether true or false.*

1. All substances expand by the same amount when heated through the same range of temperature.
2. A bimetallic strip is used to measure heat.
3. A thermometer measures heat.
4. Mercury thermometers can be used to measure temperatures below –40°C.
5. Alcohol thermometers can be used to determine temperatures above 100°C.
6. In the Fahrenheit scale, the melting point of ice is 32°F.
7. The clinical thermometer has a kink in its bore.
8. The minimum thermometer contains alcohol.
9. The maximum thermometer has an index of glass.
10. Evaporation is a cooling process.
11. Reduced pressure lowers the boiling point of liquids.

12. The pressure cooker works on reduced pressure.
13. Glass is a good conductor of heat.
14. Water is a bad conductor of heat.
15. If there were no atmosphere around us, then the sun's radiation would not be able to reach us.
16. Good absorbers are good emitters.
17. In a thermos flask the silvered surface prevents heat loss due to convection.

VI *Answer the following questions :*

1. What effect does a change of pressure have on boiling point ?
2. How can the boiling point of water be raised ?
3. Why does it take a longer time to boil eggs on mountains than in the plains ?
4. Why is mercury used in thermometers ?
5. How many degrees are there between the freezing and boiling points on a Fahrenheit thermometer?
6. Is heat absorbed or given off when a liquid evaporates ?
7. Why is ice kept in sawdust ?
8. Why is the handle of a kettle made of wood?
9. Why do we wear woollen clothes during winter ?
10. Why are the metal bars of a window cold to touch while the wooden frame does not appear to be cold ?
11. Why does hot water crack a cold glass ?
12. How would you construct and graduate a mercury thermometer ?
13. Draw a neat labeled diagram of a maximum and minimum therometer. Describe its construction and working.
14. Describe the clinical thermometer with a neat diagram.
15. Distinguish between evaporation and boiling.
16. How can you prove that different metals conduct heat differently?
17. Explain the formation of land and sea breezes.
18. Describe an experiment to prove that water is a poor conductor of heat.
19. Explain the principle and construction of Davy's safety lamp.
20. Describe a thermos flask with a neat diagram. How does it keep things cold or hot?

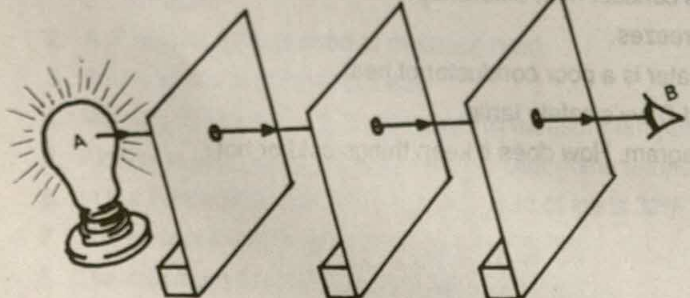
5. LIGHT

Light travels in straight lines - eclipses- reflection - curved mirrors - refraction.

Light enables us to see objects. It is a form of radiation to which the eye is sensitive — it is the electric impulses sent to our brain that enables us to see.

The sun, stars, electric lights and give out light and are called luminous bodies. All other objects reflect the light that falls on them and are called non-luminous bodies. The speed of light is (300,000 km/s).

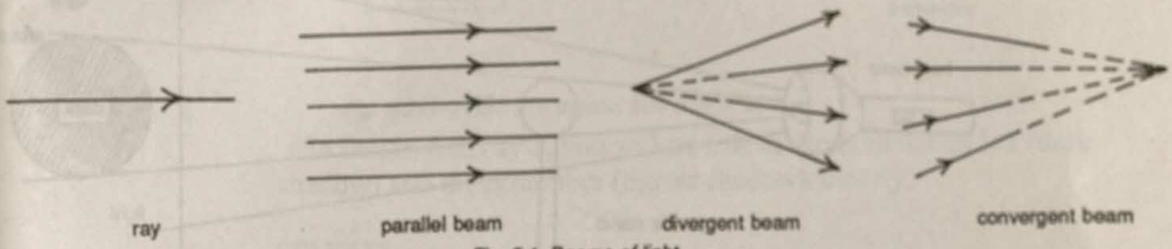
5.1 Light travels in straight lines



Activity 1 : *Take three indentical pieces of cardboard and pierce a small hole in the centre of each. Prop them up vertically with some books . Pass a length of thread through the holes and pull it tight to make sure the holes are in a straight line. Place a lamp on one side of the cardboard pieces at A and look through the other side at B as shown in the figure.*

You should be able to see the light clearly. Now move one of the cards so that the holes are not in a straight line, and again place your eye at B. Can you see the light? What conclusion can you draw from this?

The substance through which light travels is called an *optical medium*. In the given experiment, the air surrounding the lamp is the medium. A straight line in a medium along which light travels is called a *ray* of light. In reality, we cannot get a single ray of light from a source; what we get is a collection or bundle of rays called a 'beam of light' or a 'pencil of rays'. A beam of light may be parallel, converging or diverging as shown in the diagram.

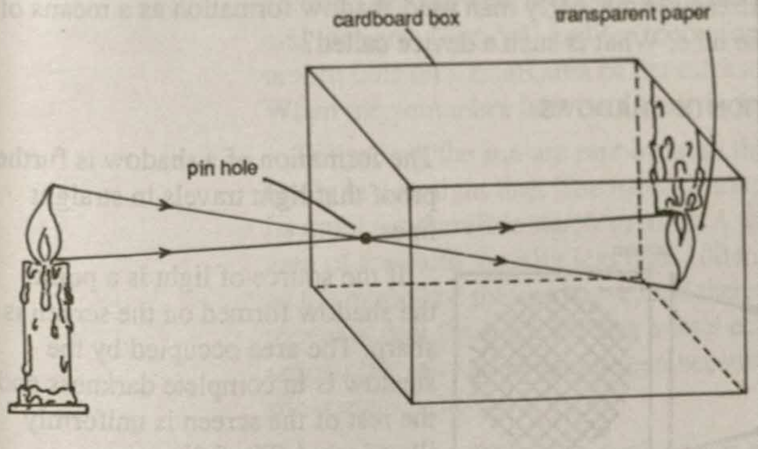


ray | parallel beam | divergent beam | convergent beam

Fig. 5.1 Beams of light

PIN HOLE CAMERA

This device was first used in the 16th century but it is easy to make your own pin hole camera.



Activity 2 : *Take a cardboard box and cut out one of the smaller faces. Stick some transparent paper over this face.*

At the centre of the opposite face, prick a small hole with a safety pin. Place a lighted candle on the table and the box about 40 cm from it. You will be able to see the image of the flame on the transparent paper. If the transparent paper is replaced by a photographic film, a photograph will be obtained.

If light did not travel in straight lines, would this image be formed?

Find out what happens when

a. the candle is moved further away from the pin hole?

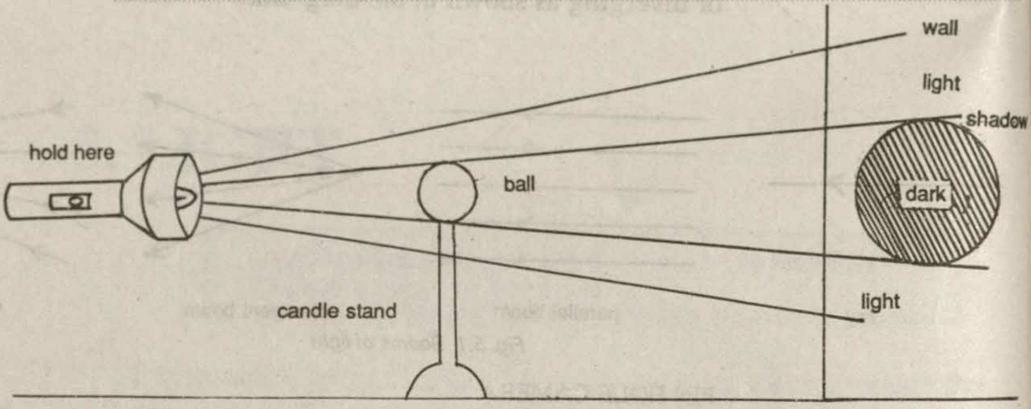
b. the length of the box is increased?

c. the size of the hole is increased?

5.2 Eclipses

Why are shadows formed?

Activity 3 : *Place a ball on a candle stand in front of a wall. The wall serves as a screen. Shine a torch on to the ball and observe the patch of light on the wall. What do you observe? Why does this happen?*



Would you get the same result if light did not travel in straight lines?

As you already know, early man used shadow formation as a means of telling the time. What is such a device called?

FORMATION OF SHADOWS

The formation of a shadow is further proof that light travels in straight lines.

If the source of light is a point, the shadow formed on the screen is sharp. The area occupied by the shadow is in complete darkness and the rest of the screen is uniformly illuminated (Fig.5.2).

If the source of light is large, the area which is in complete darkness, called the *umbra*, is surrounded by a fainter portion called the *penumbra* (Fig.5.3).

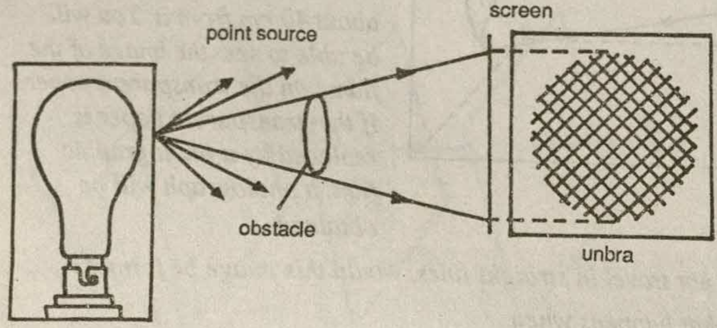


Fig. 5.2. Formation of shadow from a point source

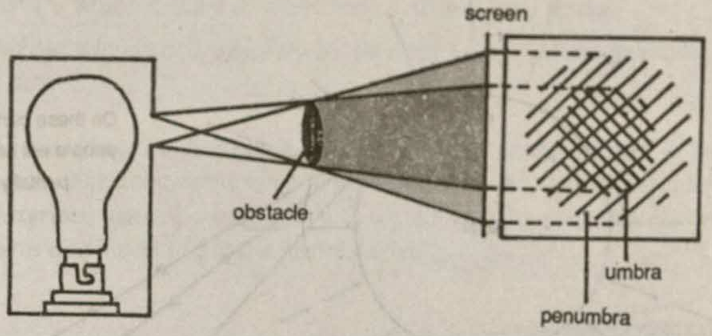


Fig. 5.3 Formation of a shadow from a large source

In fact in Activity 3, you will be able to see both the umbra (dark shadow) and the penumbra (lighter shadow), clearly.

ECLIPSES

Eclipses are formed when the shadow of the earth falls on the moon or when the shadow of the moon falls on the earth. The former is called a lunar eclipse and the latter is called a solar eclipse.

Solar eclipse : A solar eclipse is amongst the most impressive of all celestial phenomena. It occurs when the moon comes between the sun and the earth (Fig. 5.4) and the moon forms a shadow. Sometimes its umbra falls on a small area of the earth and causes a total eclipse. When the penumbra falls on the earth, there is a partial eclipse.

Eclipses of the sun are rare because the earth, moon and sun are rarely in a straight line. The moon is much smaller than the earth and its umbra is therefore much smaller. A total eclipse occurs on a small area of the earth, usually less than 100 miles wide. The shadow moves as the moon and the sun move, and therefore the area of total eclipse, moves across the earth. During a total eclipse, the glow or corona around the sun can be easily seen because there is no glare from the sun's main light.

Lunar eclipse : When the earth comes between the sun and the moon the shadow of the earth falls on the moon and a lunar eclipse occurs.

The earth forms a shadow. The umbra is about 1.6×10^6 km long, and around it is a partial shadow or penumbra. There is an eclipse of the moon when it moves into this shadow. The moon and the sun must be on opposite sides of the earth, and therefore an eclipse occurs only at full moon.

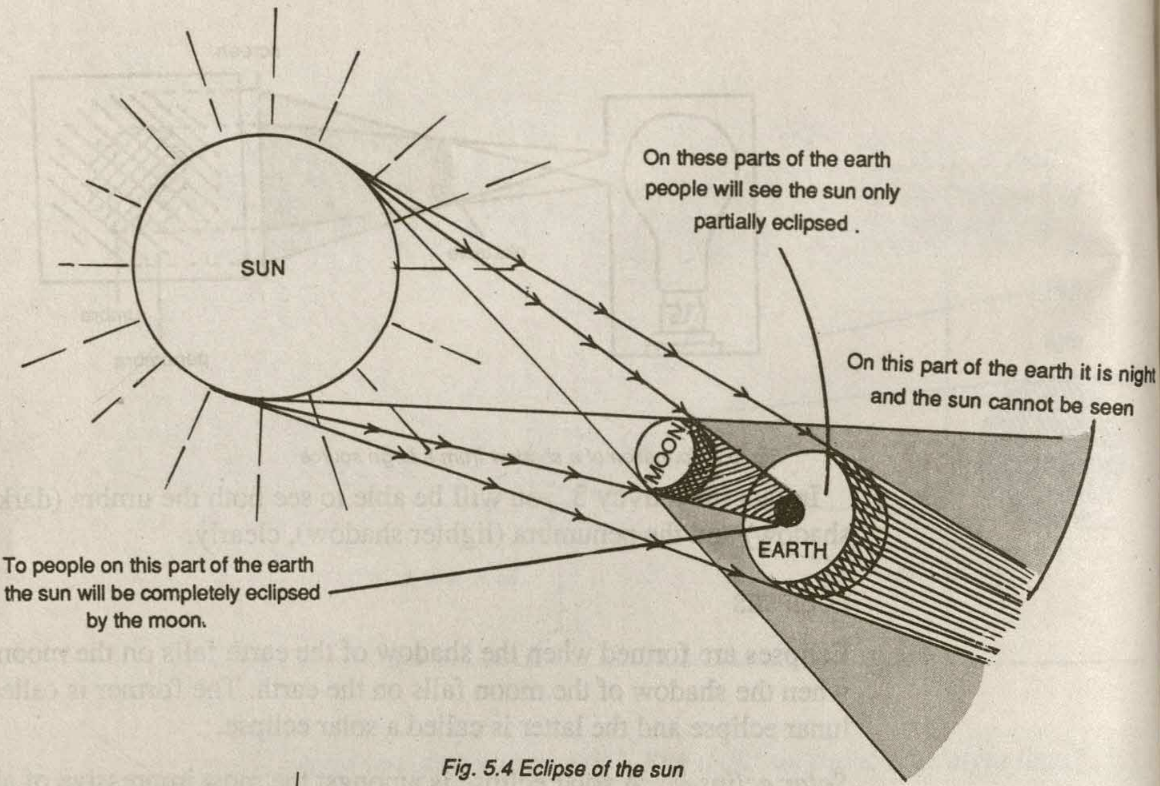

SUN
On these parts of the earth people will see the sun only partially eclipsed .
On this part of the earth it is night and the sun cannot be seen
MOON
EARTH
To people on this part of the earth the sun will be completely eclipsed by the moon.

Fig. 5.4 Eclipse of the sun

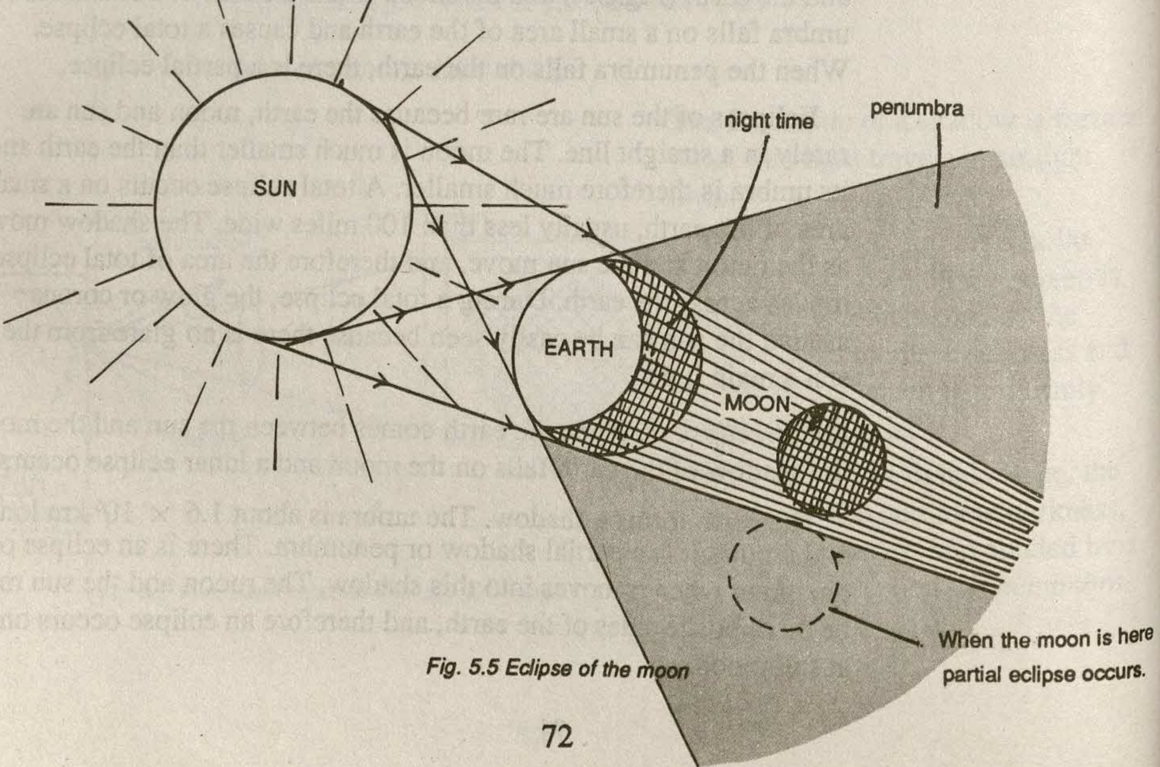
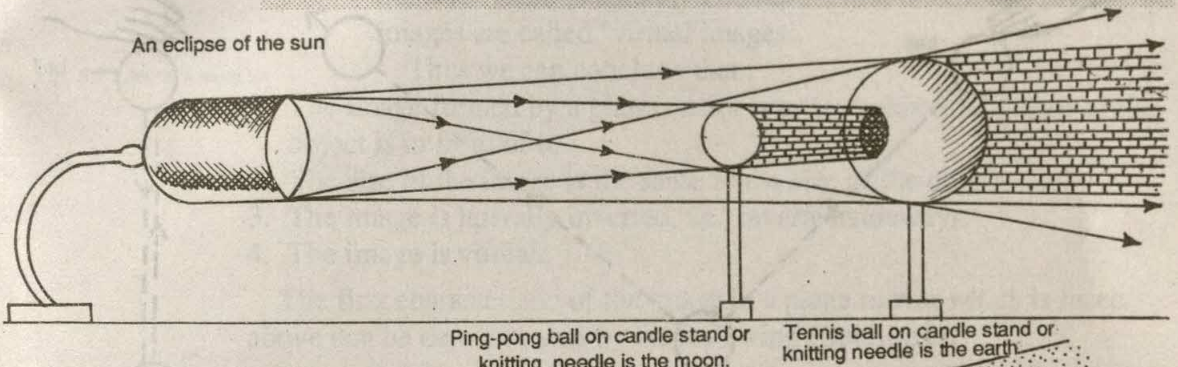


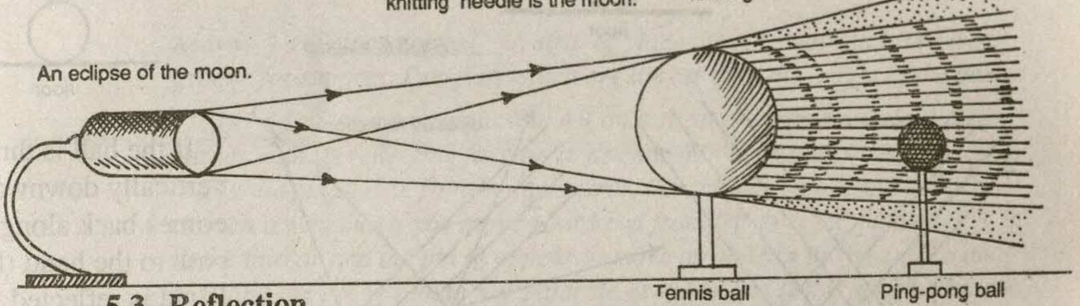
Fig. 5.5 Eclipse of the moon

Activity 4 : *Make a chart to show the formation of eclipses.*

Find out why an eclipse of the moon does not occur every month on full moon day.

Activity 5 : *Make the following models to demonstrate eclipses of the sun and moon. The demonstration will be more effective in a darkened room. The diagrams are self-explanatory. You will have to adjust the distances of the earth and moon to get the desired effect.*


An eclipse of the sun
Ping-pong ball on candle stand or knitting needle is the moon.
Tennis ball on candle stand or knitting needle is the earth.


An eclipse of the moon.

5.3 Reflection

We are able to see objects because they reflect light. We are familiar with the phenomenon of reflection of light. The surfaces of many bodies act like mirrors, while many others do reflect light but are not like mirrors.

Activity 6 : *Make a list of various surfaces that act like mirrors and reflect light. You will see that all smooth, polished surfaces are reflectors of light.*

REGULAR AND DIFFUSED REFLECTION

The type of reflection which takes place from a smooth and well-polished surface is called *regular* reflection. Light is turned back or reflected according to simple rules called the *laws of reflection.* Smooth, flat surfaces which reflect light are called plane mirrors.

When light is incident on a surface which is not smooth but irregular, the light travels in a large number of unpredictable directions. This kind of reflection is known as *diffused* reflection. This can be understood from the following example.

The reflection of light off a plane surface is very similar to the bouncing of a ball on a smooth floor (Fig.5.6a). A ball will bounce off at the same angle at which it strikes the floor.

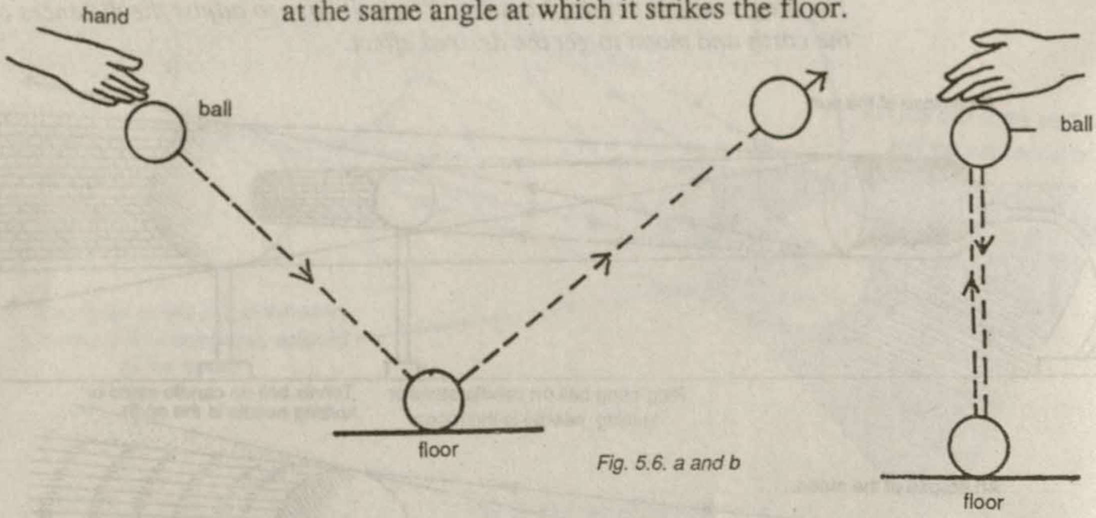


Fig. 5.6. a and b

If the ball is thrown vertically downwards it comes back along the same path to the hand (Fig.5.6b). Light is reflected from a plane surface in a similar manner.

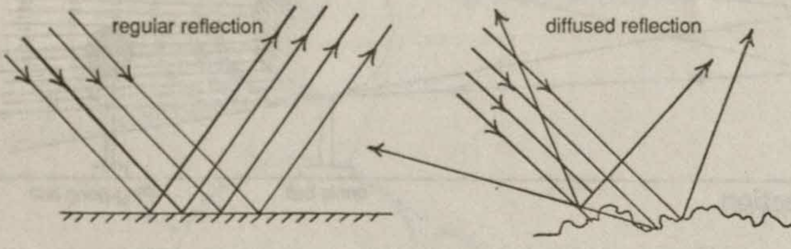


Fig. 5.7 Diffused reflection

If the floor is not smooth but rough, it will not be possible to predict in which direction the ball will bounce off. This is similar to diffused reflection (Fig.5.7).

IMAGE FORMED IN A PLANE MIRROR

Look into a mirror. What do you see? First, of course, you see your face, and then you can see many of the objects in the room. At first it may seem to you, that you are looking into a room exactly like yours. But, if you look carefully you will notice that the 'image room' is not quite the same. For one thing , you may notice that the clock in the 'image room' seems to move backwards and the numbers are also reversed sideways. A calendar on the wall in the 'image room' is also difficult to read.

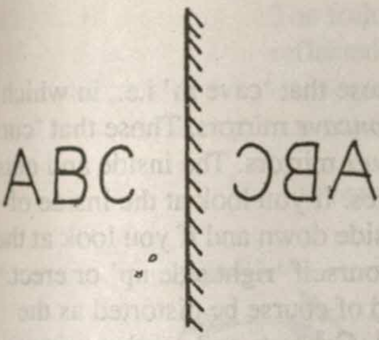


Fig. 5.7 Lateral inversion

The second thing you will notice is that your face and other objects seem to be the same size in the 'image room'. Another thing about the image in the plane mirror is that when your face is far from the mirror the image also appears to be far. As you move closer to the mirror, your image also moves closer. In fact, your image is as far behind the mirror as you are in front of it. Apart from all this, the images in a plane mirror are not real. There is actually nothing behind the mirror. Such images are called 'virtual images'.

Thus we can conclude that :

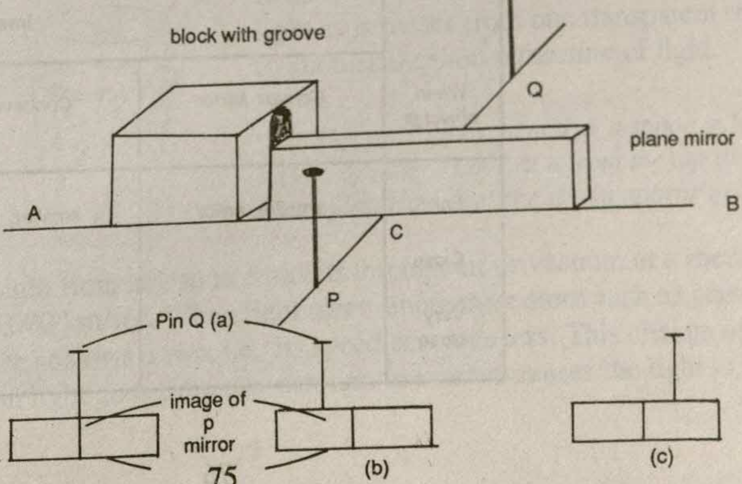
1. The image formed by a plane mirror is as far behind the mirror as the object is in front of it.
2. The size of the image is the same as the size of the object.
3. The image is laterally inverted, i.e., inverted sideways.
4. The image is virtual.

The first characteristic of the image in a plane mirror which is listed above can be demonstrated by the following experiment.

Activity 7 : *Things needed : A strip of plane mirror, wooden block with groove for support. Two pins which are longer than the height of the mirror.*

Method : Draw a straight line AB on a sheet of paper and place the mirror with its reflecting face on it as shown in the figure.

Fix the pin at P in front of the mirror. Fix the pin Q behind the mirror in such a way that if you move your head from left to right, the image of P in the mirror and the pin Q appear to move as one pin as in (a). The image of P and the pin Q should not separate as in (b) and (c). When this is done, Q gives the position of the image and there is no parallax error. Remove the pins and mark their positions. Join PQ to meet AB at C. Measure PC and QC. What do you conclude?



5.4 Curved mirrors

Some mirrors are not flat or plane. Those that 'cave in' i.e., in which the inner/surface reflects, are called *concave* mirrors. Those that 'curv out' or bulge outwards are called *convex* mirrors. The inside and outsid of a shiny spoon show different pictures. If you look at the inside of the spoon, you would see yourself upside down and if you look at the outside of the spoon, you would see yourself 'right side up' or erect. The images in both the surfaces would of course be distorted as the surfaces of the spoon are not spherical. Concave and convex mirrors are part of spherical surfaces.

In a plane mirror, the image or the reflection is always the same size, shape and the same way up (i.e. erect) as the object. With curved mirrors the image produced depends on the shape of the mirror and the distance of the object from it.

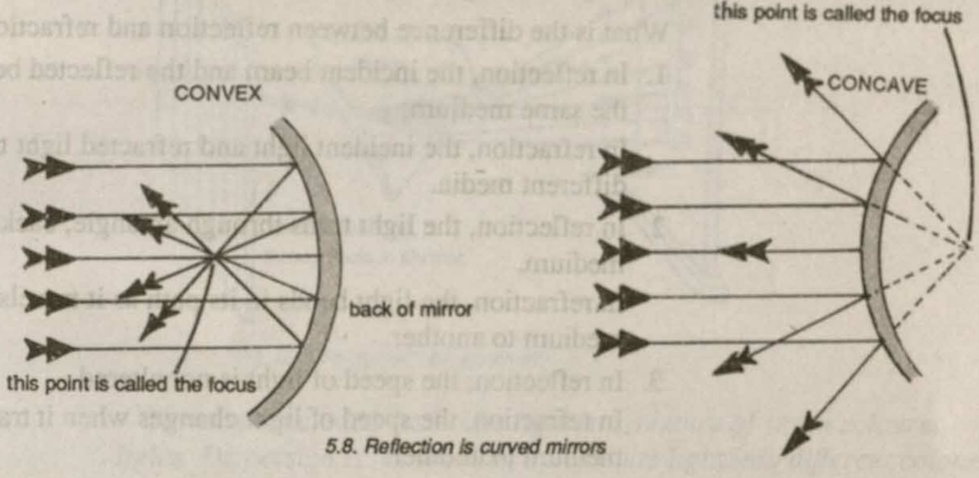
In convex mirrors the image is always smaller than the object and erect. Convex mirrors are used in cars to give the driver a wider field of view of vehicles coming at the back and overtaking at the side.

In a concave mirror, if the object is very close to the mirror, the image is upright and larger. This fact is made use of in shaving mirrors and compact mirrors. Concave mirrors are used in headlights, search lights, projectors and torches.

Activity 8 : *Take a convex mirror and look at your reflection in it. Is the image larger or smaller than your face? Is it erect or upside down? Move the mirror far from you and then closer. Is there any change in the image? Repeat the same with a concave mirror and a plane mirror. Note down your findings.*

When object is	Image In		
	Convex Mirror	Concave mirror	Plane Mirror
Far	smaller, erect	smaller, inverted	same size, erec
Close			
Very close			

The following diagrams show you how a parallel beam of light is reflected in a curved mirror.

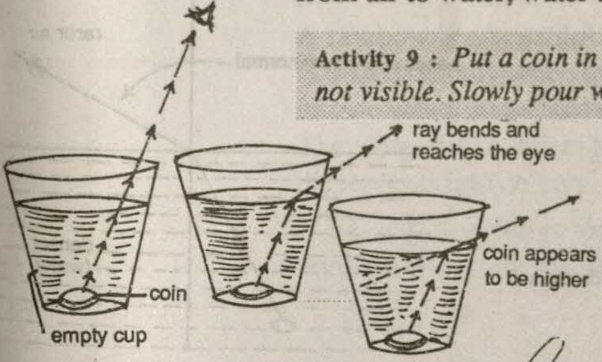

CONVEX
back of mirror
this point is called the focus
this point is called the focus
CONCAVE

5.8. Reflection is curved mirrors

5.5 Refraction.

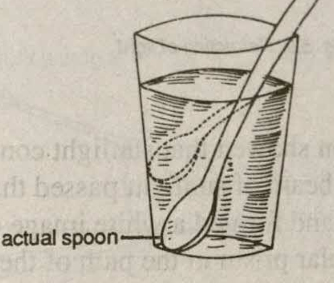
What happens to light rays when they pass through different substances from air to water, water to air, air to glass, etc?

Activity 9 : *Put a coin in a cup. Take up a position so that the coin is just not visible. Slowly pour water into the cup.*



Does the coin become visible? See that you don't change the position of your eye. Using the diagrams can you explain what happens, when water is poured into the cup? What conclusion can you draw from this?

We have seen that as the rays of light pass from water to air, they bend. This bending of light as is passes from one transparent medium to another is called *refraction* of light.



Activity 10 : *Place a pencil or a spoon in half a glass of water. Look at it from the top and from the sides. How does the spoon appear to be?*

Light from any source travels through air or vacuum at a speed of 300,000 km/sec. When light meets another medium such as glass or water, it slows down, i.e., its speed becomes less. This change of speed when light goes from one medium to another causes the light to bend.

Different transparent substances slow down light by different amounts. The speed of light in water is reduced to three-fourths its value in air and the speed of light in glass is reduced to two-thirds its value in air.

What is the difference between reflection and refraction?

1. In reflection, the incident beam and the reflected beam travel in the same medium.
   In refraction, the incident light and refracted light travel in different media.
2. In reflection, the light turns through an angle, back into the first medium.
   In refraction, the light bends in its path as it travels from one medium to another.
3. In reflection, the speed of light is not altered.
   In refraction, the speed of light changes when it travels from one medium to another.

Some facts about refraction are summed up in these diagrams.

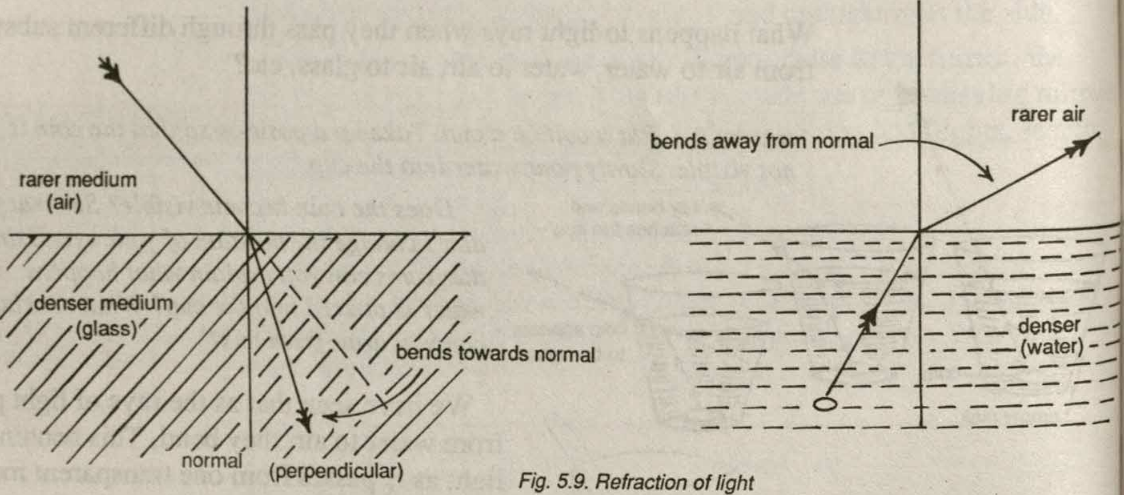


Fig. 5.9. Refraction of light

NEWTON'S EXPERIMENT

In 1666, Sir Issac Newton showed that sunlight consists of seven colours. He found that a beam of sunlight passed through a round hole in a wall of a dark room and formed a white image on the opposite wall. He placed a triangular prism in the path of the beam. A spectrum of seven colours formed on the wall (Fig. 5.11). It was not in the same position as the original white image. The red colour was deviated least from the position of the white image and the violet colour was deviated most.

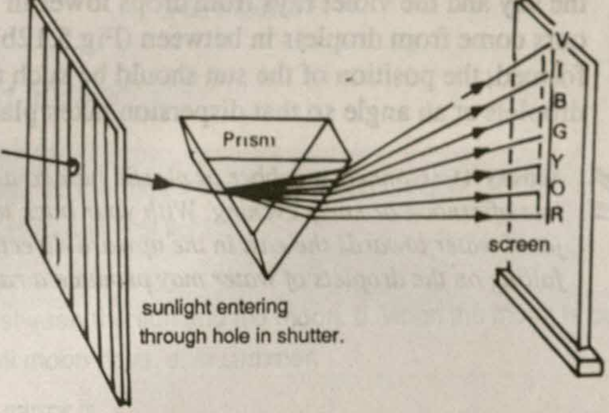


Fig. 5.11 Formation of a spectrum

Newton concluded that *white light is a mixture of seven coloured lights. Dispersion is the splitting up of white light into different colours by refraction.* Red light is refracted least and violet light most because the speed of red light in glass is faster than that of violet light.

RAINBOWS

A rainbow is a beautiful, naturally occurring phenomenon. A rainbow is observed only when there is plenty of moisture in the air in the shape of tiny water drops, and when the sun is at the back of the observer. The water drops reflect and refract the sunlight entering them and disperses it into colours.

Each drop of water forms its own little spectrum. In the actual rainbow which we see, the red rays come from water drops higher in

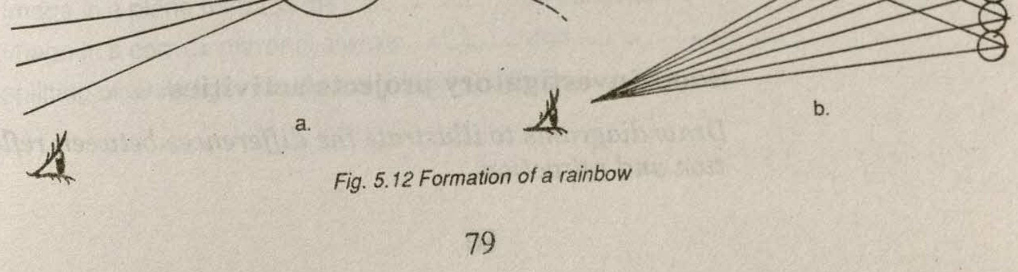
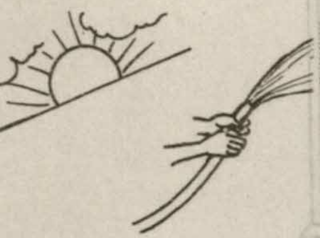


Fig. 5.12 Formation of a rainbow

the sky and the violet rays from drops lower in the sky. The other colours come from droplets in between (Fig.5.12b). For a rainbow to be formed, the position of the sun should be such that sunlight enters the droplets at an angle so that dispersion takes place.



Activity 11 : *Connect a rubber or plastic tube to a tap in the garden in the late afternoon or early evening. With your back towards the sun, spray a jet of water towards the east in the upward direction. The rays of the sun falling on the droplets of water may produce a rainbow!*

Basic concepts

1. Light travels in straight lines.
2. Shadows are formed because light travels in straight lines.
3. The darker shadow formed is called the umbra. The lighter shadow formed is called the penumbra.
4. A solar eclipse occurs when the moon comes between the sun and the earth and a lunar eclipse occurs when the earth comes between the sun and the moon.
5. Smooth, shiny surfaces are good reflectors of light.
6. The image formed in a plane mirror is as far behind the mirror as the object is in front of it, is the same size as the object and is inverted sideways.
7. In a convex mirror, the image is always smaller than the object and erect.
8. In a concave mirror, if the object is very close to the mirror the image is larger than the object and erect.
9. When light travels from one transparent medium to another, it bends or gets refracted.
10. Dispersion is the splitting up of white light into different colours.
11. A rainbow occurs when reflection, refraction and dispersion take place in water droplets.

Some investigatory projects/activities

Draw diagrams to illustrate the differences between reflection and refraction.

REVISION

I. Choose the correct answer.

1. A pin hole camera is based on
   a. the reflection of light. b. the rectilinear propagation of light.
   c. refraction of light. d. dispersion of light.
2. An eclipse of the sun can occur only
   a. when the earth is between the sun and the moon. b. when the moon is between the sun and the earth. c. on full moon days. d. in summer.
3. The image in a plane mirror is
   a. smaller than the object. b. larger than the object.
   c. upside down. d. same size as the object.
4. Depending on the distance of the object, the image can be either erect or inverted (upside down) in
   a. a concave mirror. b. a prism. c. a convex mirror. d. a plane mirror.

II. Fill in the blanks.

1. The formation of shadows proves that light travels in ....
2. If the source of light is a point, the edges of the shadow formed are ....
3. If the source of light is large, the shadow formed consists of .... parts.
4. The approximate speed of light in air is .... m per second.
5. The separation of light into its component parts is known as.................... .
6. Newton's prism experiment shows that sunlight is a mixture of .... colours.
7. The image formed in a camera is ....
8. A lunar eclipse occurs when .... is between .... and ....
9. A solar eclipse occurs when .... is between .... and ....
10. When light travels from air to glass, it bends .... the normal.
11. When light travels from glass to air, it bends .... the normal.
12. When light is reflected from a smooth surface, it is called .... reflection.
13. When light is reflected from a rough surface, it is called .... reflection.
14. The image in a plane mirror is the .... as the object.
15. The image in a convex mirror is always .... and ....
16. The splitting of white light into seven colours is called ....

III State whether true or false.

1. It is possible to get a single ray of light.
2. A beam of light which comes to a point is a divergent beam of light.
3. The image in a pinhole camera is inverted.
4. The shadow formed with a point source of light is the umbra.
5. Eclipses occur due to shadow formation.
6. Dull surfaces reflect light best.
7. The image in a plane mirror is upside down.
8. The image in a plane mirror is laterally inverted.
9. The image in a concave mirror is always erect.
10. When we look vertically into a pool, if does not appear to be as deep as it really is.

IV Match the following :

1. sun dial	a. dispersion
2. driving mirror	b. concave mirror
3. shaving mirror	c. lateral inversion
4. prism	d. rectilinear propagation
5. plane mirror	e. refraction
	f. convex mirror

V Answer the following:

1. What causes an eclipse of the sun?
2. Draw a diagram to show the shadow formed if the source of light is large.
3. Show by means of a diagram what happens to a beam of sunlight when it goes through a glass prism.
4. When light passes from air to glass, is it bent away from the normal or towards it?
5. In what direction is it bent when it emerges from the glass into air?
6. Describe an experiment to show that light travels in straight lines.
7. Draw a neat diagram to show the formation of a lunar eclipse and explain it.
8. Draw a neat diagram to show the formation of a solar eclipse and explain it.
9. What are the conditions for a rainbow to be visible?
10. Describe how you will construct a pin hole camera.
11. How will you show that the image formed in a plane mirror is as far behind the mirror as the object is in front of it?
12. Draw diagrams to show how a parallel beam of light is reflected at (a) a concave mirror, (b) a convex mirror.

6. Sound

Propagation of sound through solids, liquids and gases - wave motion - conduction - hearing and speaking - differences in sound.

6.1. Propagation of sound through solids, liquids and gases

1. SOUND TRAVELS THROUGH SOLIDS

To find out if sound can be propagated through solids, do the following simple experiments.

Activity 1 : *Hold one end of your ruler close to your ear and scratch on the other end. Note how loud the sound is. Then move the ruler away from your ear and scratch on the near end which should be at about the same distance as before. Compare the sound you hear.*
Which sound was louder?
What can you conclude from this experiment?

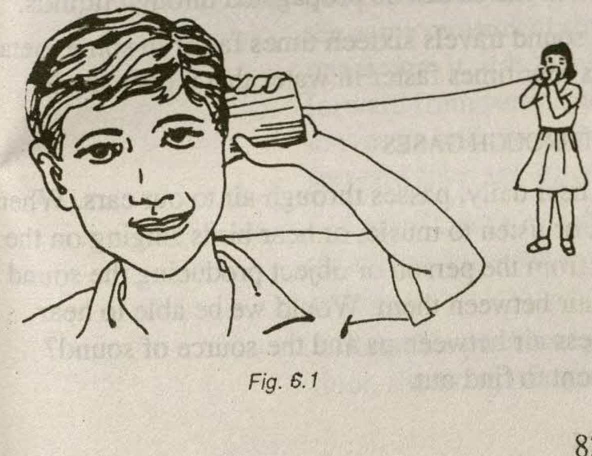
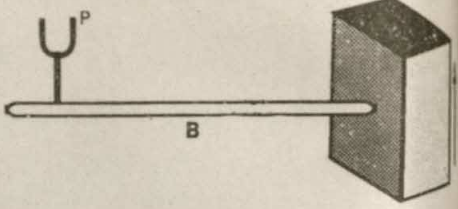


Fig. 6.1

Sound is much louder when carried by the solid ruler than when carried by air, i.e, sound travels faster through solids than it does through gases.

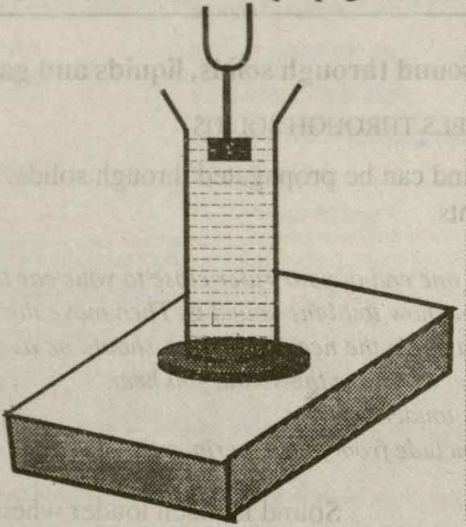
We are all familiar with sound being transmitted through the walls and floors of a building. The toy telephone used by children also illustrates that sound is transmitted by solids. Two empty tins are connected by a long thread (Fig.6.1). When one child speaks through a hollow box, the sound is carried through the thread and reaches the ear of the other child.

Activity 2 : *Take a long metal rod B and fix it to a sound box A. (A sound box is an empty wooden box.) Strike a tuning fork P and hold it in air. Place your ear near the sound box. Is the sound feeble or loud? Place the vibrating tuning fork on the rod B as shown in the figure and again place your ear near the sound box. Which sound is louder? Write down your conclusion about this experiment.*



2. SOUND TRAVELS THROUGH LIQUIDS

Sound can be propagated through liquids too.



Activity 3 : *Take two stones or marbles and click them together. Listen to the sound. Then submerge them in a basin of water and click them together again. Which sound was clearer and louder?*

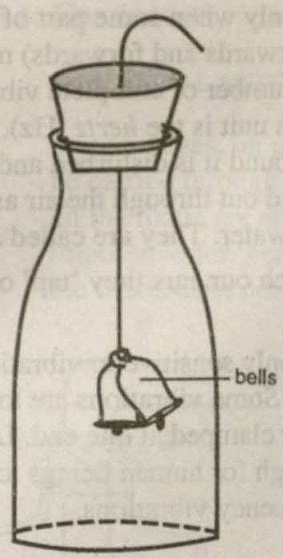
Activity 4 : *Take a glass cylinder and fix it to a sound box with sealing wax or plasticine. Also stick a small piece of wood or metal to the handle of a tuning fork. Vibrate the tuning fork and place it on the water. You will find that the vibrations are transmitted through the water to the box and are clearly audible in the room.*

Thus we realise that sound waves can be propagated through liquids.

It can be shown that sound travels sixteen times faster in some metals than in air and it travels four times faster in water that it does in air.

3. SOUND TRAVELS THROUGH GASES

Most of the sounds we hear daily, passes through air to our ears. When we speak to each other, or listen to music, or hear birds singing on the trees, the sound travels from the person or object producing the sound to our ears through the air between them. Would we be able to hear so clearly if there was less air between us and the source of sound? Do this simple experiment to find out.



Activity 5 : Things needed : *An empty round or flat-bottomed flask or even an empty milk bottle, a length of wire, one or two small bells, cork that fits the flask or bottle tightly.*

Method :*Attach the bells to one end of the wire and thread the other through the cork. Tear a sheet of newspaper into shreds and put the pieces into the bottle. Light a match and apply it to the paper. Quickly cover the bottle with the cork. The burning paper will use up the air and create a partial vacuum.*

When the bottle cools, shake it and listen. Can you hear the bells ringing? Open the cork and let in some air and seal it. Now shake the bottle again. Can you hear the bells ringing now? What conclusion can you draw from this experiment?

6.2 Wave motion

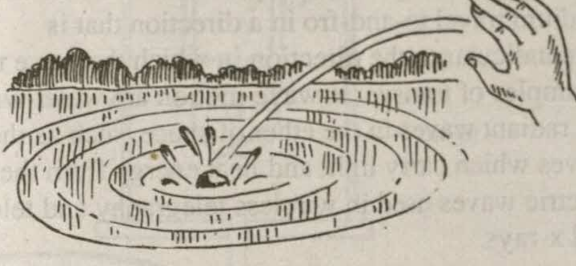


Fig. 6.2 Wave motion

We are familiar with the circular waves produced when a stone is dropped into the still water of a pond. Waves spread out from the centre of disturbance and travel outwards in widening circles. It appears as if the water is travelling towards the bank, but actually this is not so. If you watch twigs and other objects floating on the water, you will find that they only move up and down when a wave reaches them, but do not travel along with the wave. Such objects do not rise and fall together. They do so one after the other. This shows that when the waves pass over the surface of the water, each separate particle does not perform the same movement simultaneously, but each one a little later than the one before it. It is therefore clear that it is the wave which travels forward from particle to particle, while every particle of the water moves up and down about its own position of rest. It does not move forward from one place to another.

The vibratory movement of a series of particles in a medium as described above gives rise to a wave and the motion is called a *wave motion.*

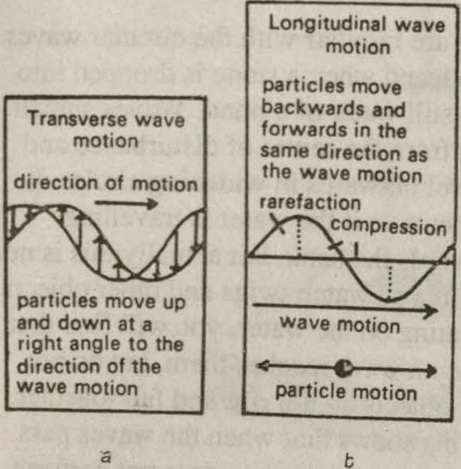
Sound is produced by movement or vibration—the slamming of a door, the firing of a gun, the ticking of a clock, etc. A musical instrumentsproduces sound only when some part of it is vibrating. A *vibration* is a to-and-fro (backwards and forwards) movement that is continuously repeated. The number of complete vibrations per second is called the *frequency*, and its unit is the *hertz* (Hz). The moment something vibrates, the air around it is disturbed and begins to vibrate. These vibrations, which spread out through the air as spheres of motion, are very much like waves on water. They are called *sound waves*.

When sound vibrations reach our ears they 'tap' our eardrums and make them vibrate.

The average human ear is only sensitive to vibrations of frequency between 20 and 20,000 hertz. Some vibrations are too slow to produce a sound, e.g., a vibrating ruler clamped at one end. Dogs can hear the note of a whistle that is too high for human beings to hear. Bats can make and hear very high frequency vibrations.

TRANSVERSE AND LONGITUDINAL WAVE MOTIONS

These are two types of wave motion. In transverse wave motion (Fig.6.3a), the particles of the transmitting medium travel to-and-fro in a direction that is perpendicular to the direction in which the wave moves. Examples of transverse wave motion are water waves, the radiant waves in the ether of space, such as the waves which carry light and heat energy from the sun, electric waves used in wireless telegraphy and telephone and x-rays.


Transverse wave motion
direction of motion
particles move up and down at a right angle to the direction of the wave motion
Longitudinal wave motion
particles move backwards and forwards in the same direction as the wave motion
rarefaction
compression
wave motion
particle motion

a b

Fig. 6.3

In longitudinal wave motion (Fig.6.3b) the particles of the transmitting medium travel backwards and forwards in the same direction as the wave instead of in a direction perpendicular to it. An example of longitudinal wave motion is sound waves in air or any other medium.

The velocity of sound in air at 0°C is 332 metres per sec.

The figure below shows the *compressions* (C) and *rarefactions* (R) produced in air as a tuning fork vibrates.

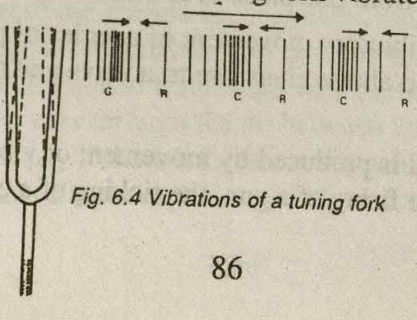


Fig. 6.4 Vibrations of a tuning fork

6.3 Conduction

A MATERIAL MEDIUM IS NECESSARY FOR THE PROPAGATION OF SOUND

Sound waves, unlike light, cannot pass through vacuum. Sound can only be carried through a medium — solids, liquids and gases. Astronauts on the moon are equipped with radios to speak to each other. It is impossible for them to talk to each other as they do on the earth because the moon does not have an atmosphere through which sound can travel.

The fact that sound waves require a medium was discovered by Otto van Guericke in 1654.

Suspend an electric bell by a cotton thread from the stopper of a bell jar, and set it ringing (Fig.6.5) Pump out the air from the bell jar. As the air is withdrawn from the jar you will find that the sound gets feebler and ultimately is heard very faintly, although the working of the bell can be seen inside the jar. This experiment shows that sound is not transmitted through vacuum but requires a material medium for its transmission. The sound of the bell does not completely die away, because some of it is transmitted by the suspending wires.

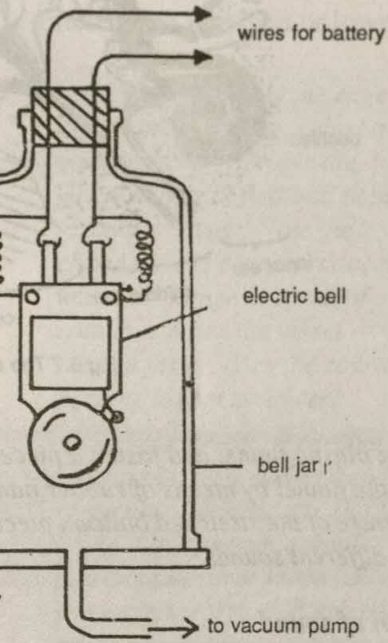


Fig. 6.5 Bell jar experiment

6.4. Hearing and speaking

Of all sources of sound, the voice is the most wonderful. The vocal chords in the larynx are two flat elastic membranes whose thickness, length and tension can change the frequency of sound emitted according to the wishes of the person.

How does this voice box produce all the sounds humans are capable of producing? Air from the lungs passing through these membranes sets them in vibration producing sound. The cavities of the larynx, the mouth and the nose act as resonators and make the vibrations (sound) audible. When we whisper, the vocal chords do not vibrate and the feeble sound is produced only by the mouth and tongue.

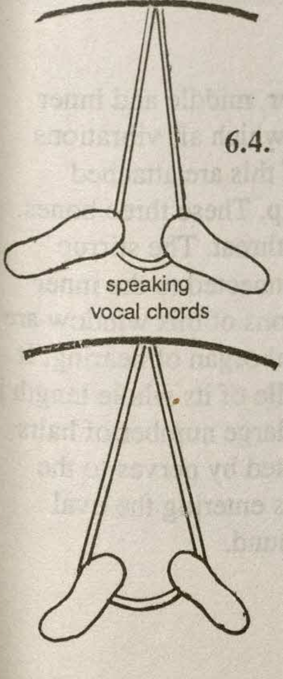


Fig. 6.6

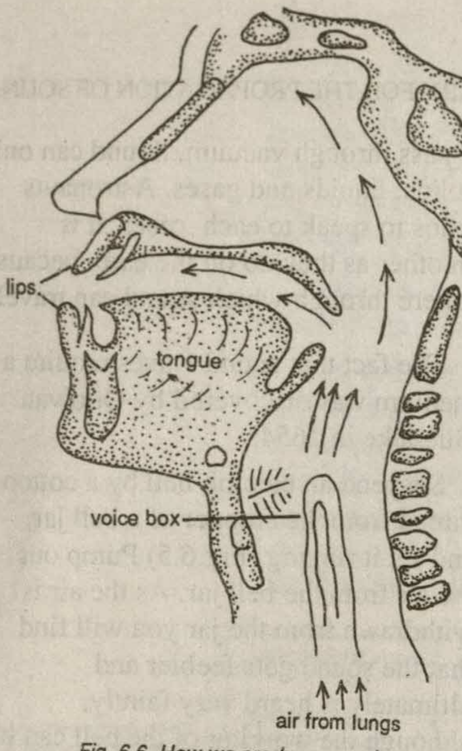
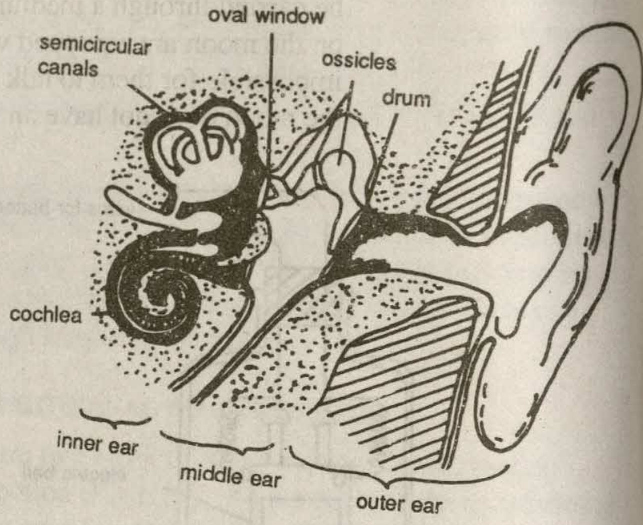


Fig. 6.6. How we produce sound



F.g 6.7 The ear

Activity 6 : *Take a plastic funnel and fasten a piece of balloon stretched over the mouth of the funnel by means of rubber bands. Using a blade cut a slit across the centre of the stretched balloon piece. Blow through the funnel to produce different sounds.*

Ear and perception of sound

The ear consists of three distinct parts, the outer, middle and inner ear (Fig. 6.7). The outer ear is the cavity down which air vibrations travel and ends in the eardrum. To the inside of this are attached three little bones—the hammer, anvil and stirrup. These three bones form the *middle ear*, which is connected to the throat. The stirrup presses against the oval *window*, a tiny bone connected to the inner ear, which is embeddedin the skull. The vibrations of this window are communicated to the 'cochlea', which is the real organ of hearing. It consists of a spiral tube. Coiling down the middle of its whole length is the 'basilar membrane', which is made up of a large number of hairs stretched across its width. The hairs are connected by nerves to the brain, and stimulation of the hairs by vibrations entering the oval window produces the sensations we know as sound.

6.5 Differences in sounds

We are all familiar with the fact that all sounds we hear do not sound the same. The sound of the voice of a child is different from that of a man or a woman. The sounds produced by different musical instruments sounds different. This is because there are certain characteristics of sound which makes one sound different from another. The three main characteristics of sound are *pitch*, *loudness* and *tone*.

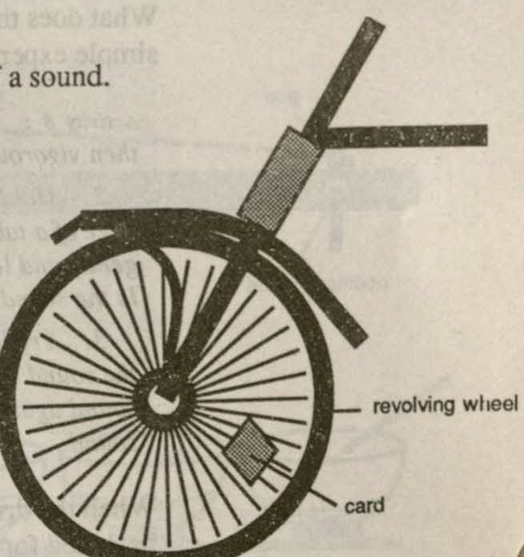
I. PITCH.

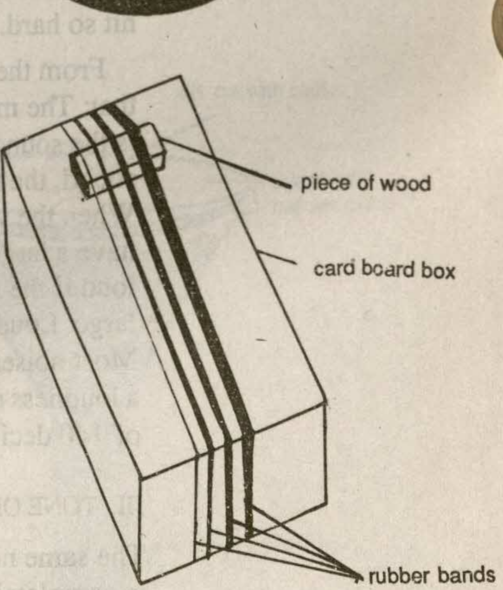
Pitch is the highness or lowness of a sound.

Activity 7 : *1. Hold the edge of a card or thin stick against a bicycle wheel. Revolve the wheel slowly at first and then faster and faster. Note the change in the sound produced with the change in speed of rotation. When the wheel rotates faster, does the sound became higher or lower?*

2. Take an empty cardboard box and insert 4 rubber bands of various thickness around it. Make a bridge with a small piece of plastic or wood as shown in the figure. Pluck each string one by one and compare the sounds produced. Which string has a higher sound? Now shorten the string by moving the bridge and again pluck the strings and compare the sounds. You can shorten the rubber band by inserting a tack-nail and stretching the string tighter and plucking it.

Write a report on the different types of sound produced.





From (1), you can conclude that pitch depends on the number of vibrations per second. The greater the number of vibrations per second the higher the pitch, i.e., pitch depends on the frequency of vibration. From (2) we deduce that the pitch depends on the tension, length and thickness of a string.

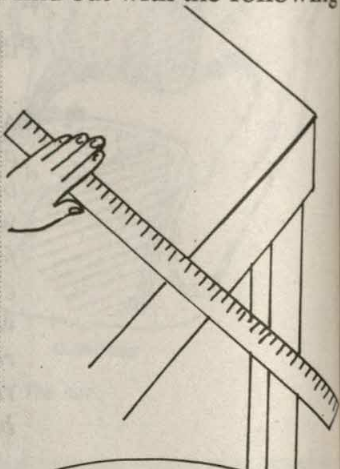
II. LOUDNESS

The loudness of a sound does not depend on the speed of vibrations. What does the loudness depend on? You can find out with the following simple experiments.

Activity 8 : *1. Clap your hands gently and then vigorously.*

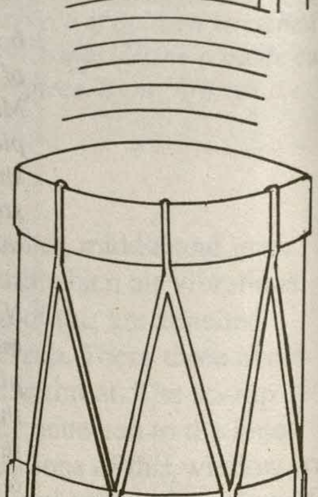
2. Hold one edge of a ruler over the edge of a table. Pull the other end down gently and let go. Repeat with a harder pull. Is the sound louder the second time?

3. Try hitting a drum very lightly. Note the sound. Hit it a bit harder and note the sound again. Hit it very hard and note the sound.



When the drum is hit hard the skin goes back and forth farther than when it is not hit so hard.

From the above experiments we see that: The more force you apply, the louder is the sound produced. The louder the sound, the farther the body vibrates. When the vibrations are large we say they have a large amplitude. Hence, sound is loud if the amplitude of vibrations is large. Loudness is measured in decibels. Most noises in and around our homes have a loudness of about 70 decibels. A loudness of 140 decibels becomes intolerable.

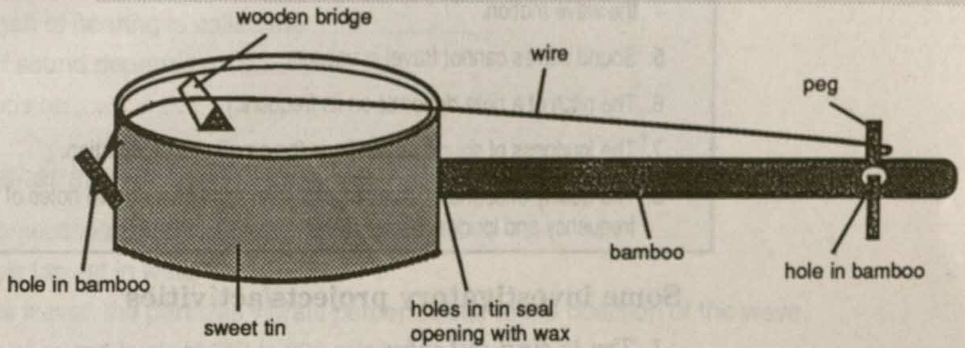


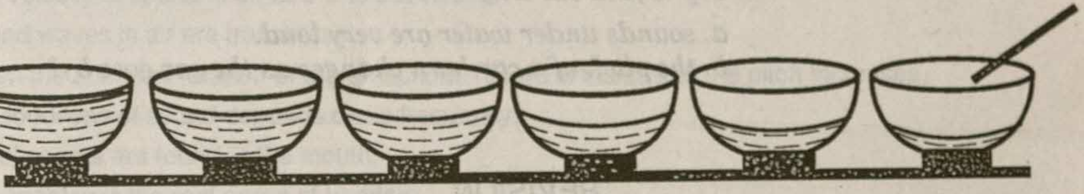
III. TONE OR QUALITY OF SOUND

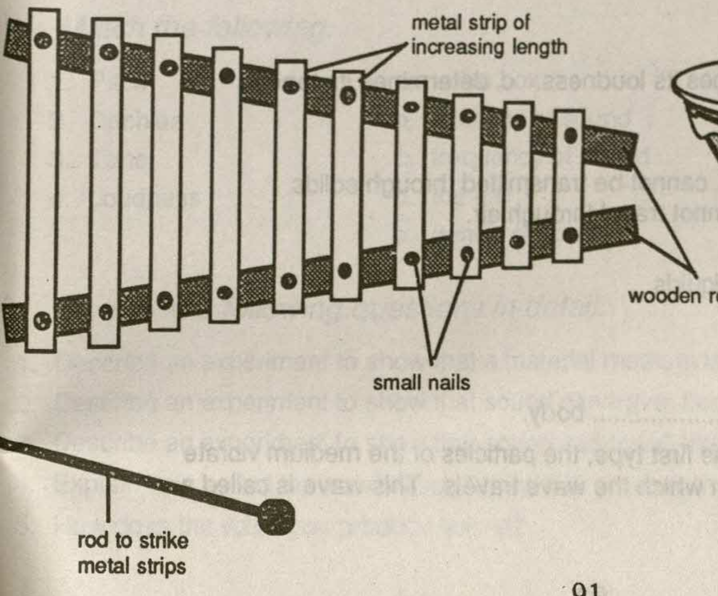
The same note is played on a violin and a trumpet the sound heard is completely different even though both have the same frequency. Why is this?

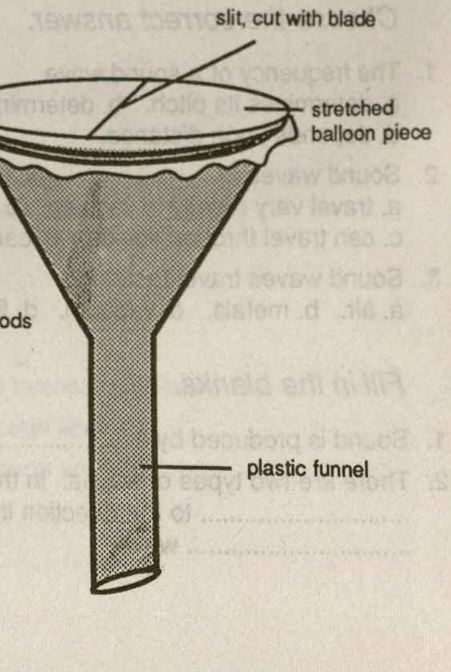
Each note of an instrument is formed from a harmony of many notes apart from the actual note required. This differs from instrument to instrument. Hence, it is the quality of the sound which enables us to distinguish between two notes having the same frequency and loudness.

Activity 9 : *The following diagrams show you how to make a few musical instruments. Make them and try to play simple tunes on them! Can you devise other musical instruments?*









Basic concepts

1. Sound can travel through solids, liquids and gases.
2. Sound is produced by vibrating bodies and travels as a wave motion.
3. In transverse waves, the particles move up and down at right angles to the direction of wave motion.
4. In longitudinal waves, the particles move backwards and forwards in the direction of the wave motion.
5. Sound waves cannot travel in vacuum.
6. The pitch of a note depends on its frequency.
7. The loudness of sound depends on the amplitude of vibration.
8. The quality of sound enables us to distinguish between two notes of the same frequency and loudness.

Some investigatory projects/activities

1. Try to find out why

a. sounds under water are very loud.
b. the pitch of a car horn changes as the car goes by?

REVISION

I. Choose the correct answer.

1. The frequency of a sound wave
   a. determines its pitch. b. determines its loudness. c. determines its tone.
   d. depends upon distance.
2. Sound waves
   a. travel very rapidly in vacuum. b. cannot be transmitted through solids.
   c. can travel through liquids. d. cannot travel through air.
3. Sound waves travel faster in
   a. air. b. metals. c. vacuum. d. liquids.

II. Fill in the blanks.

1. Sound is produced by a .... body.
2. There are two types of waves. In the first type, the particles of the medium vibrate .... to the direction in which the wave travels. This wave is called a .... wave.

3. The other type of wave is called the .... wave. Here the particles of the medium vibrate in the .... direction in which the wave travels.
4. Sound requires a .... to travel.
5. Sound does not travel through ....
6. Sound travels through air in the form of .... waves.
7. Sound travels at the speed of .... metres per second.
8. The three bones that form the middle ear are the ...., ..., and stirrup.
9. The tiny bone connected to the inner ear is called the ....
10. The real organ of hearing is called the ....
11. Loudness of sound depends on ....
12. Pitch depends on ....

III *State whether true or false.*

1. A medium is necessary for the propagation of sound.
2. Sound travels fastest in water.
3. In transverse waves the particles vibrate perpendicular to the direction of the wave.
4. The velocity of sound in air at 0°C is 332 m/sec.
5. Sound waves in air are transverse.
6. When the speed of rotation of a gramopnone record is increased, the pitch increases,
7. The loudness of sound depends on its frequency.
8. Vocal chords are found in the mouth.
9. The cochlea is the real organ of hearing.
10. A whisper is produced by the vocal chords.

V *Match the following.*

1. Pitch
2. Cochlea
3. Tone
4. Loudness

a. voice box
b. intensity of sound
c. frequency of sound
d. the ear
e. quality of sound

Answer the following questions in detail.

1. Describe an experiment to show that a material medium is necessary to carry sound.
2. Describe an experiment to show that sound can travel through liquids.
3. Describe an experiment to show that sound can travel through solids.
4. Explain how sound from a vibrating tuning fork reaches the ear.
5. How does the voice box produce sound?

7. Magnetism

Properties of a magnet - making magnets - care of magnets - uses

About 3,000 years ago it was observed that an iron ore called magnetite attracted small pieces of iron and that a bar of it always pointed in the same direction when swinging freely. It was called *magnetite* after the town of Magnesia in Asia Minor, where it was first discovered. Chinese sailors used a long thin bar to help them to find in which direction to sail. They floated it on wood in water. One end always pointed north. This ore was called *lodestone*, which means 'leading' stone. Later, it was noted that a bar of iron or steel rubbed with lodestone also attracted small pieces of iron.

7.1 The properties of a magnet

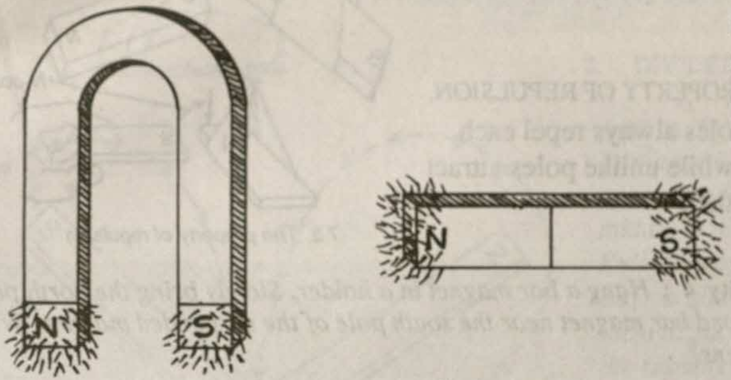
1. PROPERTY OF ATTRACTION

Magnets have the property of attracting certain metals (e.g., soft iron) towards them.

Activity 1 : Things needed : *A bar magnet, a horse-shoe magnet and some iron filings.*

Method : *Dip the bar magnet in the iron filings and take it out. Repeat with the horse-shoe magnet. Do the iron filings stick all over the magnets? Where do most of the iron filings cling?*
Where does the least number of filings collect? Compare the number of filings collected at each end.

The point near the ends of the magnets where the magnetic force is concentrated are called the poles of the magnet. Poles are always found in pairs. A horse shoe magnet is more powerful than a bar magnet because both its poles can be brought to act on an object with equal force at the same time.



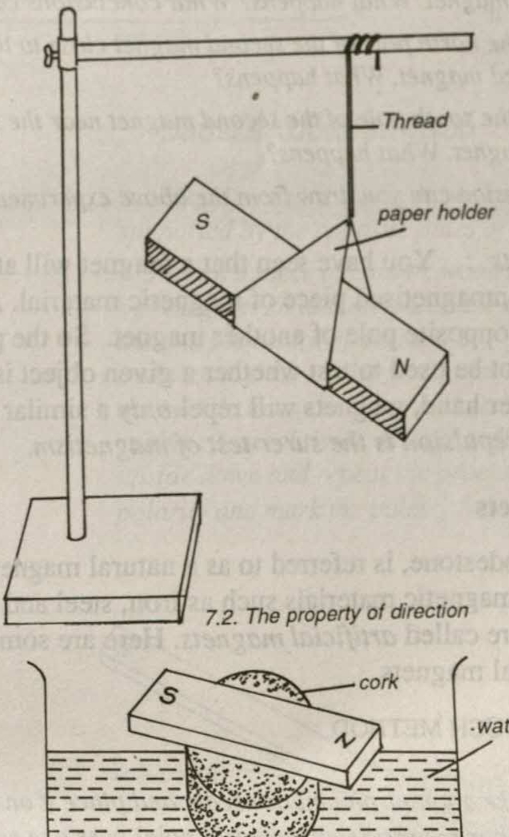
7.1. The Property of attraction

2. PROPERTY OF DIRECTION

A freely suspended magnet will always come to rest in a north-south direction.

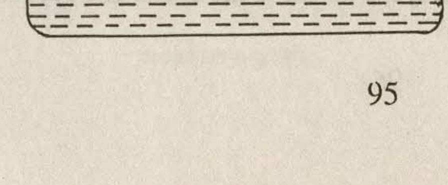
Activity 2 : *Make a paper holder as shown in the diagram. Suspend a magnet in it by a thin thread attached to a wooden stand.*

Let it swing freely until it comes to rest. Note the direction in which it points. Repeat this several times. You will notice that the magnet always comes to rest in a fixed direction which is, approximately, north and south.



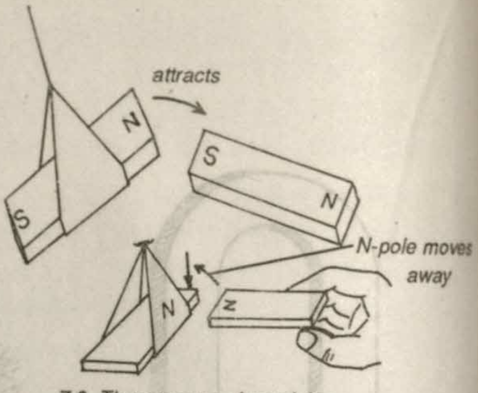
7.2. The property of direction

The end of the magnet pointing towards the north is called the north-seeking pole or north pole, and the end pointing towards the south is called the south-seeking pole or south pole.



Activity 3 : *Place a small magnet on a piece of cork and place it in a dish of water. Note* *the direction in which it comes to rest. Disturb it and again see the direction in which it comes to rest.*

3. PROPERTY OF REPULSION. Like poles always repel each other, while unlike poles attract each other.



7.3. The property of repulsion

Activity 4 : *Hang a bar magnet in a holder. Slowly bring the north pole of a second bar magnet near the south pole of the suspended magnet. What happens?*

Now bring the south pole of the second magnet close to the north pole of the hanging magnet. What happens? What conclusions can you draw?

Next bring the north pole of the second magnet close to the north-pole of the suspended magnet. What happens?

Then bring the south pole of the second magnet near the south pole of the hanging magnet. What happens?

What conclusion can you draw from the above experiments?

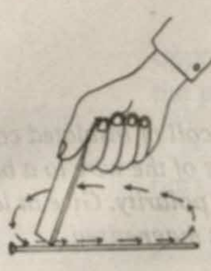
Test for magnets : You have seen that a magnet will attract iron filings or any unmagnetised piece of magnetic material. A magnet will also attract the opposite pole of another magnet. So the property of attraction cannot be used to test whether a given object is a magnet or not. On the other hand, magnets will repel *only* a similar pole of another magnet hence *repulsion is the surer test of magnetism.*

7.2 Making magnets

The iron ore, lodestone, is referred to as a natural magnet. Magnets can be made from magnetic materials such as iron, steel and alloys, such as alnico. These are called *artificial magnets*. Here are some ways of making artificial magnets.

1. SINGLE TOUCH METHOD

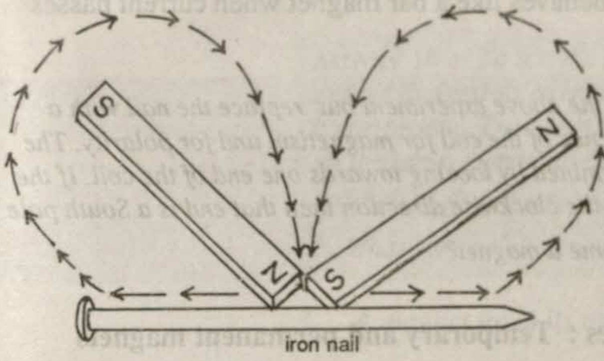
Activity 5 : *Take a long iron nail or needle and place it on a table. Hold one pole of the bar magnet (say, the north pole) over one end of the nail. Rub it from one end of the needle to the other. Then lift the bar magnet*



well away and bring it down once again over the first end. Repeat the above process about 50 times. Test whether the nail has become a magnet. Also test the polarity at the ends.

Mark the North Pole and South Pole.

2. DIVIDED TOUCH METHOD



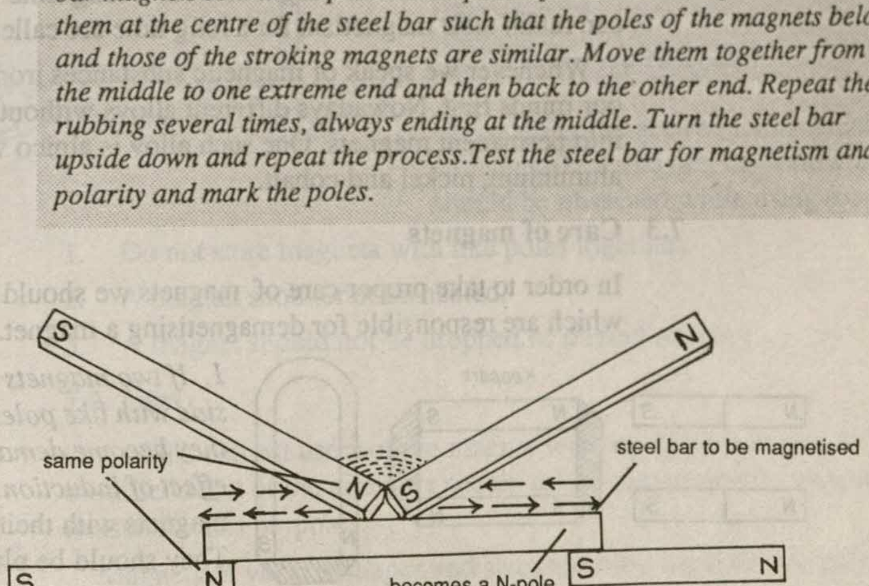
Activity 6 : *Place an iron nail which is to be magnetised on a table and place the opposite poles of two magnets at the middle of the nail as shown in the figure. Pull them apart from the middle to the ends as shown. Lift them and again place them in the middle as before and repeat the rubbing for several times.*

Test whether the nail has become a magnet, also test the polarity at the ends and mark the North pole and South poles.

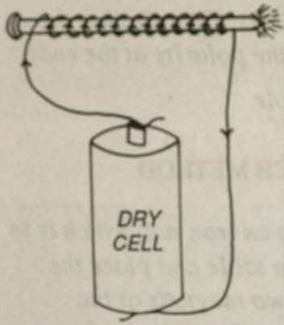
3. DOUBLE-TOUCH METHOD

Activity 7 : *Place the steel bar or iron nail to be magnetised so that it is supported by the opposite poles of two bar magnets as shown.*

Fasten a piece of cork or wood between the opposite poles of two other bar magnets so that the poles are kept at a fixed distance apart. Place them at the centre of the steel bar such that the poles of the magnets below and those of the stroking magnets are similar. Move them together from the middle to one extreme end and then back to the other end. Repeat the rubbing several times, always ending at the middle. Turn the steel bar upside down and repeat the process.Test the steel bar for magnetism and polarity and mark the poles.



4. ELECTRICAL METHODS



Activity 8 : *Take an iron nail and wind a coil of insulated copper wire over it as shown. Connect the two free ends of the wire to a battery. Test the two ends of the nail for magnetism and polarity. Give at least two methods by which you will test if the nail is magnetised.*

A coil of wire itself behaves like a bar magnet when current passes through it.

Activity 9 : *Repeat the above experiment but replace the nail with a pencil. Test the two ends of the coil for magnetism and for polarity. The polarity can be determined by looking towards one end of the coil. If the current is flowing in the clockwise direction then that end is a South pole.*

Can a pencil become a magnet?

Magnetic substances : Temporary and permanent magnets

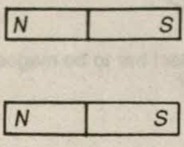
A magnetic substances is one which can be magnetised. Pure iron, i.e., soft iron can be easily magnetised, but it loses its magnetism easily. Magnets made out of soft iron are called *temporary* magnets. Very strong magnets can be made of soft iron and hence they are used as electromagnets.

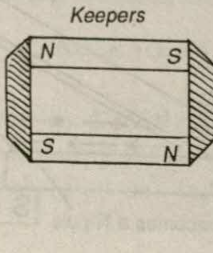
On the other hand, steel, which is iron containing a small percentage of carbon can retain its magnetism for a long time. Such magnets which can retain their magnetism for a long time are called *permanent* magnets.

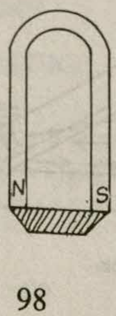
Whenever we speak of magnetic substances iron and steel come to our minds first. Nowadays different alloys without iron can be made into permanent magnets. One such alloy is alnico which is made up of aluminium, nickel and cobalt.

7.3 Care of magnets

In order to take proper care of magnets we should know the factors which are responsible for demagnetising a magnet.







1. *If two magnets are placed side by side with like poles next to each other, they become demagnetised due to the effect of induction.* Hence, never store magnets with their poles side by side. They should be placed in pairs with

opposite poles side by side and two pieces of soft iron placed across the poles called *keepers*.

A single piece of soft iron should be placed across the poles of a horse shoe magnet.

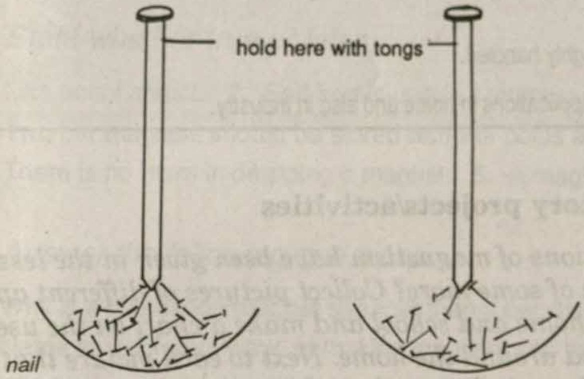
2. Heating demagnetises a magnet and hence magnets should not be heated or kept near a fire.

Activity 10 : *To test the above statement take one of the nails you magnetised and test its strength by seeing how many tack-nails or paper clips it can pick up. Then heat it with a spirit lamp and then test whether it picks up the same number of clips. Heat it for a longer time and test it again.*

What do you observe each time you heat it?

What conclusion can you draw from this?

3. A magnet loses its magnetism if treated roughly or dropped.



Activity 11 : *Take one of the nails you magnetised earlier and give it a few blows with a hammer after testing its magnetism as in activity 10. Now see how many small nails or paper clips it can attract. Repeat the experiment after giving it a few more blows with the hammer. What do you observe?*

What can you conclude?

Considering the above factors which demagnetize a magnet, the following should be observed while using magnets:

1. Do not store magnets with like poles together.
2. A magnet should not be heated.
3. A magnet should not be dropped or treated roughly.

7.4. Uses

One of the earliest users of the magnet were navigators at sea. A modified form of the compass needle called the mariner's compass is used for this purpose.

Magnets of various shapes and sizes are used for different purposes.

In our homes, too, magnets are used in a number of appliances, for example the dynamo of a bicycle; the meter for measuring electricity, the telephone receiver, the loud speaker in the radio or transistor set, refrigerator doors, etc. Tape and video recorders use magnetic tapes.

Basic concepts.

1. A magnet has the property of direction.
2. A magnet has the property of attraction and repulsion.

* A magnetic substance can be magnetised by the 1. single touch method 2. double touch method 3. divided touch method 4. electrical method.

3. Magnets made out of soft iron do not retain their magnetism for long. Such magnets are called temporary magnets.
4. Magnets which can retain their magnetism for a long time are called permanent magnets.
5. For proper care of magnets, they should not be
   (i) stored with like poles together.
   (ii) heated.
   (iii) dropped or roughly handled.
6. Magnets find wide applications in home and also in industry.

Some investigatory projects/activities

1. A few applications of magnetism have been given in the lesson. Can you think of some more? Collect pictures of different appliances used in home and school and make a chart on the uses of magnets in and around the home. Next to each picture that you paste on the chart, indicate where the magnet is used in that particular device.

REVISION

Choose the correct answer.

One of the following is not a magnetic substance
a. an alloy of aluminium, nickel and cobalt. b. copper. c. iron. d. steel.

II Fill in the blanks.

1. Magnetic attraction was first discovered in an iron ore called................ .
2. A magnet has ....poles. One is called the ....pole and the other is called the ....pole.
3. If the south pole of one magnet is brought near the north pole of another magnet, they.........................each other.
4. A magnetic needle which is suspended so it can turn freely will come to rest in a.........................direction.
5. Like poles.........................each other and unlike poles.........................each other.
6. The magnetic attraction of a magnet is least at its.........................
7. The magnetic attraction of a magnet is greatest at its.........................
8. ....is the surest test of magnetism.
9. A magnet which loses its magnetism easily is a.........................magnet.
10. Magnets which retain their magnetism for long periods are.........................
11. When a magnet is heated, it becomes......................... .
12. Pieces of soft iron placed across the poles of bar magnets to preserve them are called ....

III State whether true or false.

1. Like poles attract. 2. Soft iron is used as temporary magnets.
3. Two bar magnets should be stored with like poles adjacent to each other.
4. There is no harm in dropping a magnet. 5. A magnet should not be heated.

IV Answer the following questions.

1. Why is a horseshoe magnet stronger than a bar magnet?
2. Name four different ways of making magnets and describe one method in detail.
3. What are natural and artificial magnets?
4. Describe a simple experiment to show that there are two kinds of magnetic poles.
5. 'Repulsion is the surest test of magnetism'. Explain.
6. you are given two identical steel bars and told that only one is a magnet. How would you find out which of them is the magnet?
7. You are given a bar magnet and a magnetised knitting needle. How will you find out which end of the needle is a North Pole and which end a South Pole?
8. Name some appliances where magnets are used.
9. How will you store magnets?
10. How will you show that a magnet loses its magnetism on heating?
11. How will you show that a magnet loses its magnetism when hammered?

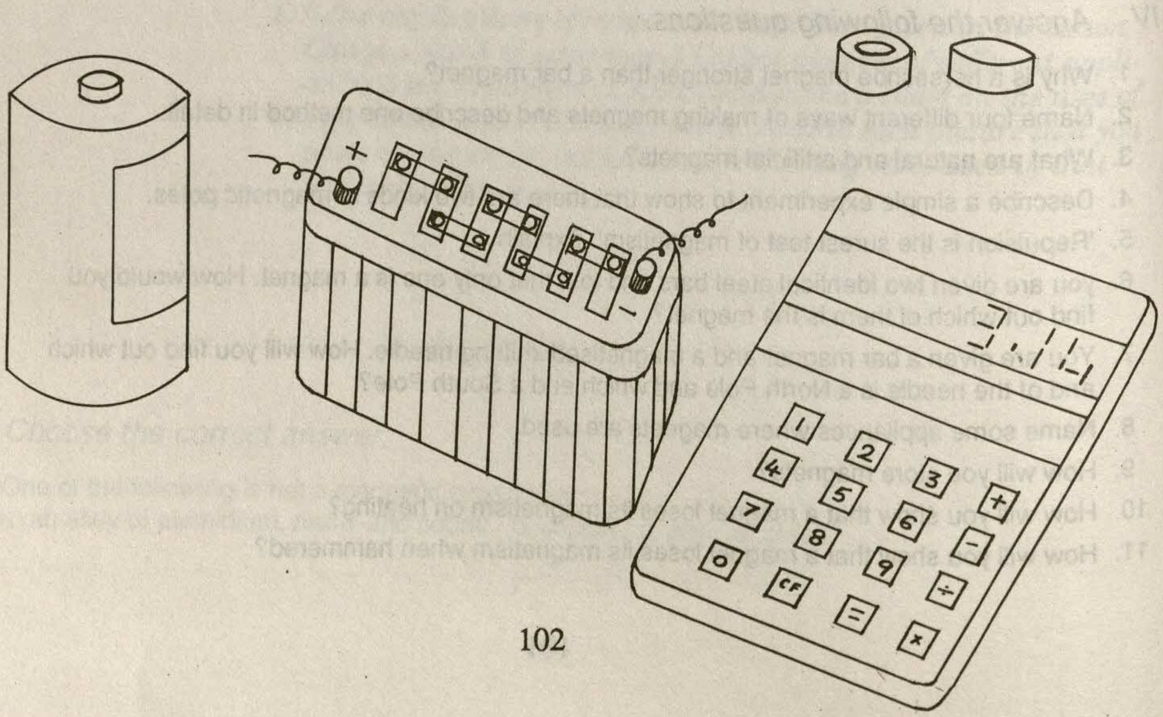
8. Electricity

Sources - cells and generators - magnetic effect of a current.

8.1 Sources of electricity

Electricity is a form of energy which has many different applications. We use it for lighting, heating, cooking, etc and for appliances like radio, television, etc. We are so used to pressing a button or turning on a switch for our daily appliances that we never stop to think, 'Where does our electricity come from?'

Activity 1 : *Name the sources of electricity in the appliances given below.*



When we switch on a lamp, we see the result of a whole series of processes which we rarely think about. Electricity comes into our homes via cables which are linked to a power station. We refer to this source of electricity as the electricity mains supply. For many appliances in our homes, like the refrigerator, electric oven, etc., we use the main supply as the source of electricity. Some of them may have their own source of energy, e.g., a torch light, digital watch, etc.

Activity 2 : *Make a list of the electrical appliances in and around your home. Name the source of electricity used in each case.*

8.2 Cells and generators

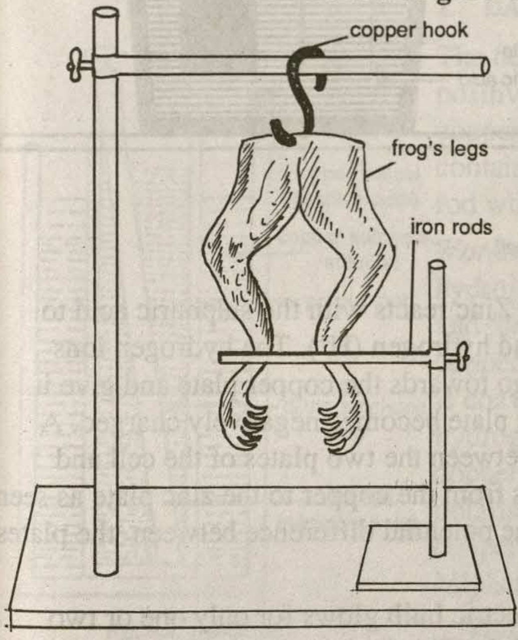


Fig 8.1 Galvani's experiment

An electric current is the continuous flow of electrons from a conductor at a lower potential to another conductor at a higher potential. Electrons move from one body to another when there is a difference of potential between the bodies. A continuous supply of electrons can be obtained from an electric cell.

In 1791, an Italian scientist named Galvani discovered that a dead frog's legs twitched when touched by two dissimilar metals. He called this *animal electricity*. Another Italian physicist, Volta, believed that the electricity making the frog's leg twitch was not present in the muscle, but had something to do with the two metals and the liquid in the frog's leg. He tested different combinations of metals connected by salt solutions rather than muscle.

To prove that the source of electricity was not the frog's legs but two dissimilar metals, Volta constructed a *voltaic pile strips* . It consisted of silver and zinc separated by *disks* of cardboard and soaked in salt solution. A shock was received when the top and bottom disks were touched simultaneously.

Experiments with the voltaic pile led to the construction of the simple cell called the *voltaic cell.*

A SIMPLE VOLTAIC CELL

This consists of a plate of copper and a plate of zinc dipped in dilute sulphuric acid contained in a glass vessel (Fig. 8.2). The two plates are provided with binding screws. When the two plates are connected by a conducting wire, chemical reaction takes place and an electric current is

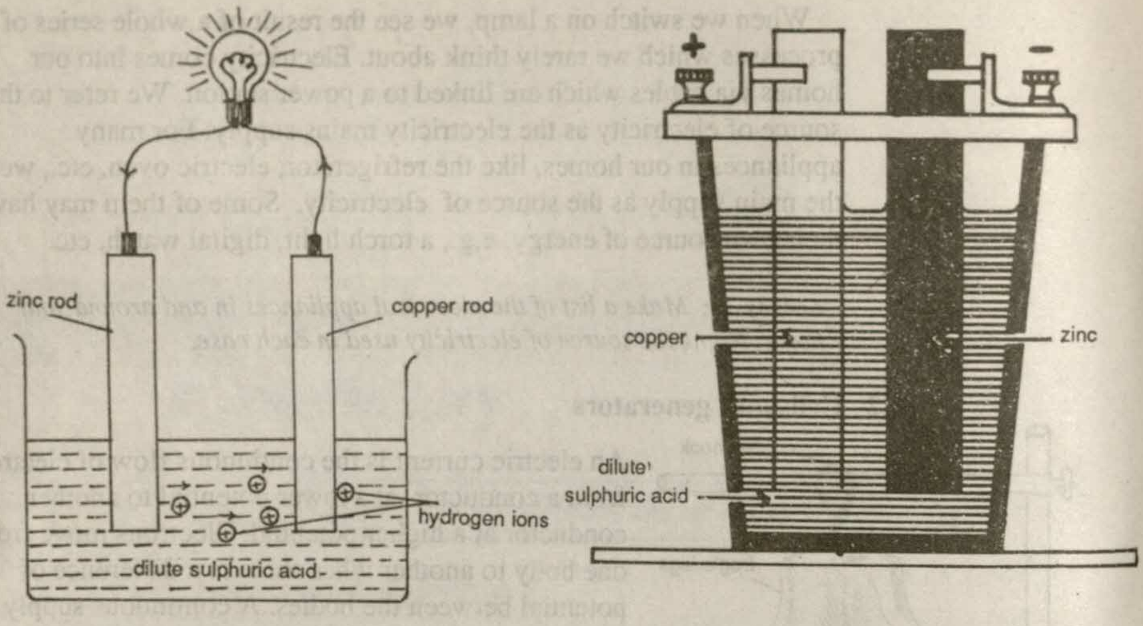


Fig. 8.2 A simple cell

seen to flow through the wire. Zinc reacts with the sulphuric acid to form zinc sulphate ($ZnSO_4$) and hydrogen (H^+). The hydrogen ions which are positively charged go towards the copper plate and give it their positive charge. The zinc plate becomes negatively charged. A potential difference is set up between the two plates of the cell and hence an electric current flows from the copper to the zinc plate as seen by the glowing of the bulb. The potential difference between the plates is about 1.1 volts.

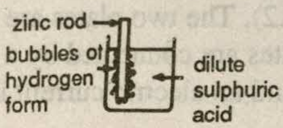
It will be noticed that the electric bulb glows for only one or two minutes and then it begins to fade. This is due to two defects.

Defects of a simple cell

1. *Local action* : The zinc plate dissolves even when no current is drawn from the cell. This is due to impurities such as specks of carbon in the zinc rod. The impurities form small cells called *local cells*, on the zinc rod itself. The zinc is thus wasted. This defect is called *local action.*

Prevention : This defect is remedied by rubbing the zinc rod with mercury. The zinc forms an amalgam on the surface with the mercury, and the impurities remain underneath.

2. *Polarisation* : Hydrogen ions go towards the copper plate in the form of bubbles, and deposit their positive charge on it. These bubbles



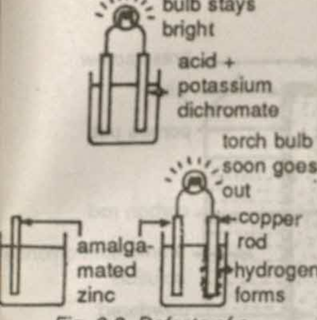


Fig. 8.3 Defects of a simple cell

occupy space on the copper plate and prevent other hydrogen bubbles from depositing their charge on it. The current flowing through the bulb becomes less and the glow of the bulb becomes dimmer. This defect is known as *polarisation.*

Prevention : This defect can be minimised by brushing the bubbles from the copper plate from time to time. This is not very convenient, and so the hydrogen is removed by allowing it to react with a chemical called *depolariser*. The cells which make use of depolarisers are called *primary cells*. Two such cells in common use are the *Daniell cell* and the *Leclanche cell.*

1. DANIELL CELL

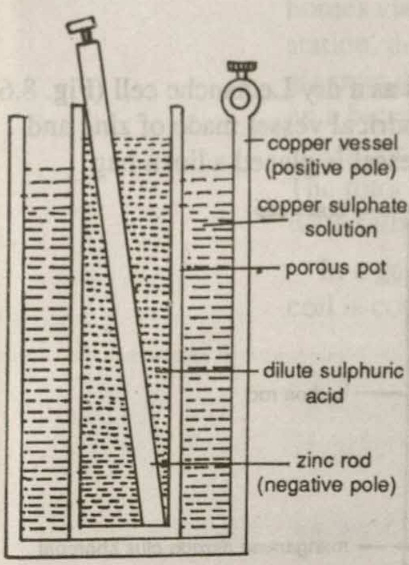


Fig. 8.4 Daniell cell

The depolarisers used here is a copper sulphate solution. The positive pole of the cell is a copper vessel which contains the copper sulphate solution. Inside this is placed a porous pot containing dilute sulphuric acid into which is dipped the zinc rod which is the negative pole (Fig. 8.4).

Working : The zinc reacts with the dilute sulphuric acid to give hydrogen and zinc sulphate. The zinc gets the negative charge and the hydrogen passes through the porous pot towards the copper plate. It first reaches the copper sulphate solution and is converted into sulphuric acid and copper. So, instead of the hydrogen being deposited on the copper vessel, the metallic copper is deposited on the inside of the copper vessel. Thus, polarisation is avoided. To maintain the concentration of the copper sulphate solution, a perforated shelf with copper sulphate crystals is provided at the top part of the vessel.

This cell gives a constant voltage of 1.1 volts.

2. LECLANCHE CELL

The liquid in this cell is sal ammoniac (ammonium chloride) solution kept in a glass jar. The positive pole is a rod of carbon packed around with powdered carbon and manganese dioxide held in a porous pot (Fig. 8.5). The top of the porous pot is sealed with pitch. This is placed in the glass jar containing sal ammoniac. A zinc rod kept dipped in the jar forms the negative pole.

The depolariser here is the manganese dioxide powder.

Working : The first action is the solution of zinc in ammonium chloride. Hydrogen bubbles are released. These bubbles pass through

the holes in the porous pot towards the carbon rod. Before reaching the carbon, they come into contact with manganese dioxide which oxidises the hydrogen to water. The carbon rod gets positively charged.

The voltage of this cell is 1.5 volts. This cell is useful where a constant current is not required, such as in an electric bell.

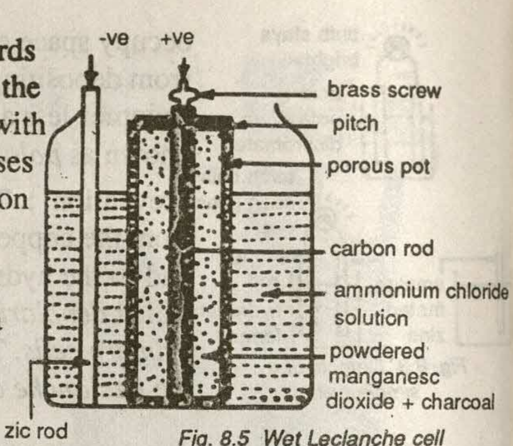

-ve
+ve
brass screw
pitch
porous pot
carbon rod
ammonium chloride solution
powdered manganesc dioxide + charcoal
zic rod

Fig. 8.5 Wet Leclanche cell

3. DRY CELL

Construction

The torch cell is really what is known as a dry Leclanche cell (Fig. 8.6). In this cell the negative pole is a cylindrical vessel made of zinc and covered with cardboard. Inside this vessel is placed a linen bag containing a carbon rod, which is the positive pole, surrounded by a paste of powdered manganese dioxide and carbon. Around the linen bag is a paste of ammonium chloride called sal ammoniac, and zinc chloride. The paste is held together by mixing it with flour, or gum and glycerine. The top of the zinc vessel is sealed with pitch. The potential difference between the two poles of the cell is 1.5 volts.

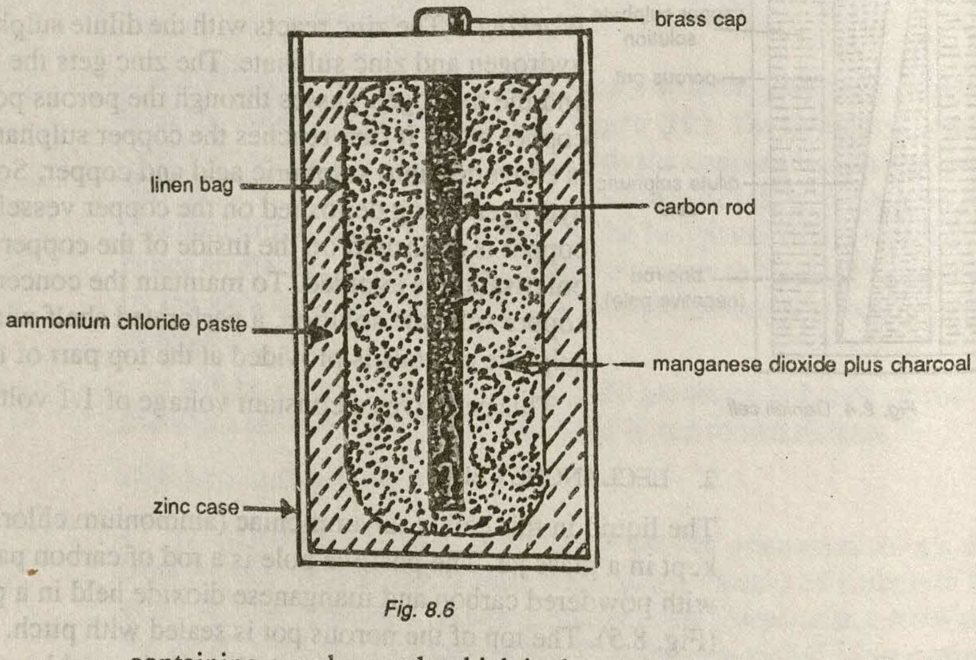


Fig. 8.6

4. SOLAR CELL.

You have already read about the solar cells in chapter 4. They can be made from several different substances. Some kinds use selenium, others use cuprous oxide. When sunlight strikes these substances a small electric current is started.

Activity 3 : *Name some uses of solar cells which you may have heard about or have learnt about.*

GENERATORS

We have already mentioned in Sec. 8.1 that electricity comes into our homes via cables which are linked to a power station. In the power station, the electric current is produced by generators. These are gigantic dynamos which work very much the same way as the dynamo on a bicycle. A bicycle wheel turns the dynamo relatively slowly but a generator needs to turn much faster than this and so a turbine is used. The rotor of the turbine may be turned by the force generated from waterfalls or by steam.

In a generator the mechanical energy required to rotate the magnet or coil is converted into electrical energy.

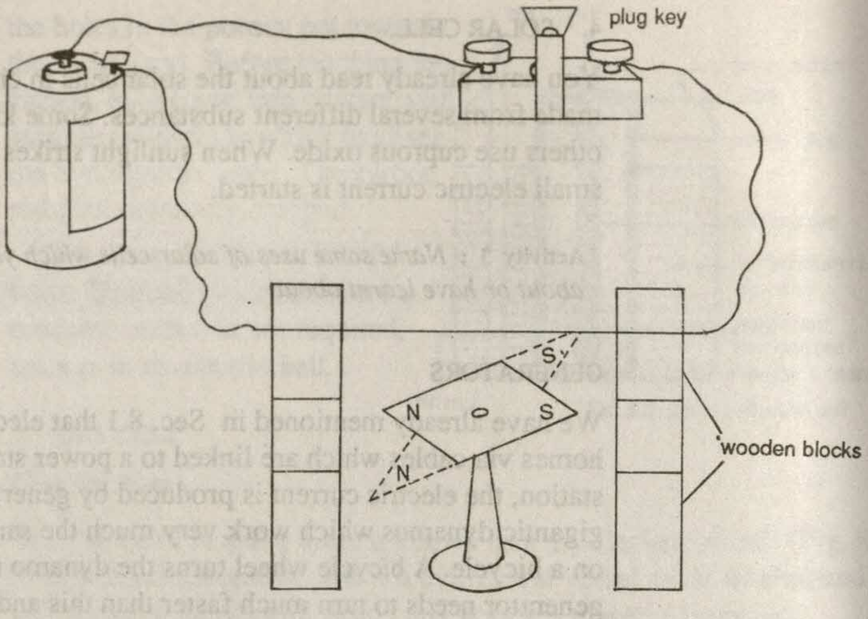
Activity 4 : *Find an old unused bicycle dynamo and dismantle it. Examine the parts. What are the main parts? Find out which part rotates when contact is made with the rim of the wheel.*

8.3 Magnetic effect of an electric current

The Danish scientist Hans Oersted discovered that an electric current produces a magnetic field around it.

Activity 5 : *Things needed : A battery, some insulated copper wire, a pivoted magnetic needle, a plug key.*

Method : Connect the wires as shown. Make sure that the insulation is removed from the ends of the wire. See that part of the wire is stretched lightly. You can use some blocks of wood or books to stretch it. Put in the plug of the key and watch the magnetic needle. Change the direction of current by interchanging the wires connected to the battery and again note the deflection of the magnetic needle.



ELECTROMAGNETS

You have already seen how to make an electromagnet in the last chapter. You would have noticed that the bar on which the coil was bound loses its magnetism once the current is switched off. The ability to turn a magnet on and off makes an electromagnet a useful device.

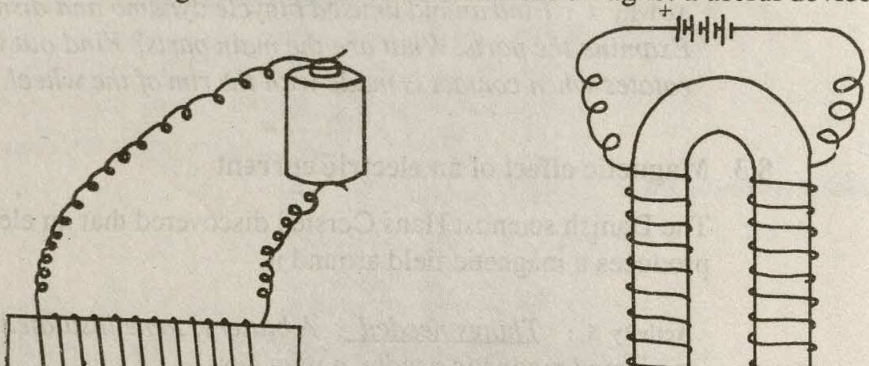


Fig. 8.7 Electromagnets

Bar magnet

Horse-shoe magnet

Look at the solenoid from one end (Fig. 8.9). If the current flows in a clockwise direction, that end acts like a South pole, if it flows in an anticlockwise direction, that end acts like a North pole.

Electromagnets are used in cranes for lifting and transferring iron parts. In iron works, they are used for breaking large pieces of cast iron into smaller ones. When used for such a purpose, a heavy iron ball is lifted by an electromagnet attached to a crane. The ball is dropped on the pieces of iron by breaking the circuit of the electromagnet. Some common uses of electromagnets are in the construction of electric bells, telegraph, telephones and transformers.

Electric bell

This instrument works on the principle of the electromagnet. The electromagnet NS is of the horse-shoe type (Fig.8.8). One end of the coil which is wound around the electromagnet is connected to the terminal T_1. The other end is connected to a metal strip *P*. This strip is connected to a soft iron armature *A* that is joined to the pivot *B* by a spring. The armature carries a rod at the end of which is a small hammer. The metal strip is in contact with a screw *Q*. The hammer is very close to a gong. The screw *Q* is connected by a wire to the terminal T_2.

When the current is switched on, it flows around the coils of the electromagnet. The electromagnet then attracts the armature. The armature moves, and the strip is pulled away from the screw *Q*, thereby breaking the circuit. As the current stops, the electromagnet stops attracting the armature and the spring pulls it back. Contact is thus remade and the circuit is completed. Each time the circuit is completed, the hammer strikes the gong. The making and breaking of the circuit causes the hammer to vibrate against the gong, and a ringing sound is heard.

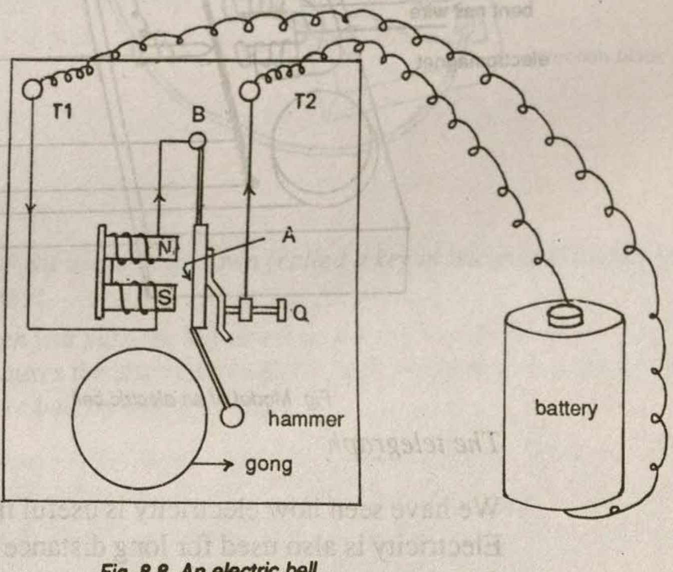


Fig. 8.8 An electric bell
A armature ; B pivot ; NS electromagnet ; P metal strip; Q, screw ; T1 and T2 terminals

Activity 6 : Find out if there is a model of an electric bell in your school. Connect it to a battery and carefully study the parts and its working. Now make your own model of an electric bell.

Things needed : A large nail bent into the shape of a U (get someone older to do it for you), some insulated copper wire, a piece of a bicycle spoke or any other flexible metal rod, a match box, cellotape, tack-nails, board-pins, screws, an empty shoe-polish tin, a wooden board, plasticine, batteries.

Method : The following diagram shows you how to assemble the electric bell with the above materials. You may have to do some adjustments of distances before you succeed. The diagram is self-explanatory. You can use any other materials that are convenient.

Fix the electromagnet and screw onto the board with plasticine. The match box can be fixed with a tack-nail or board-pin.

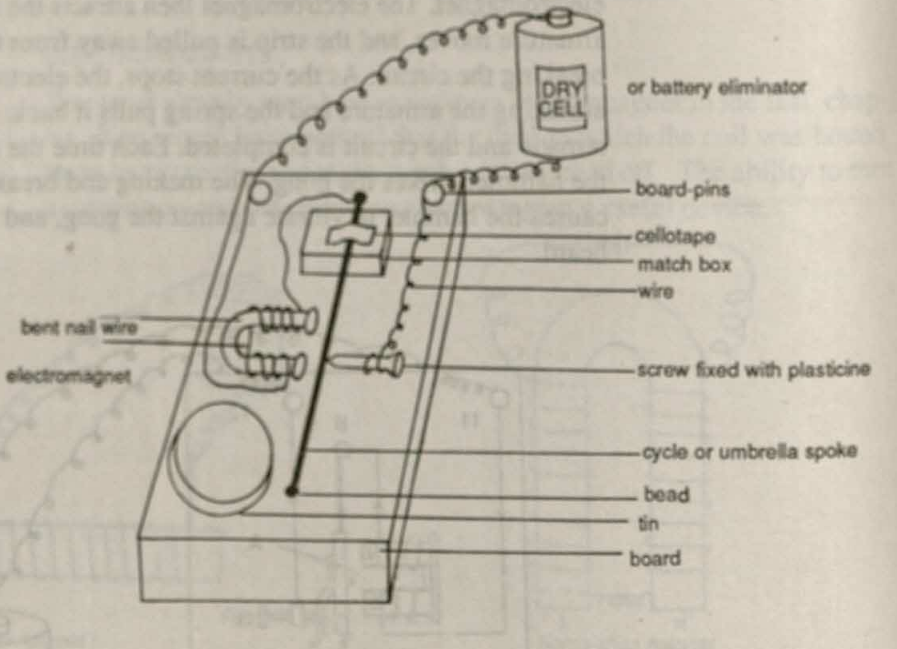


Fig. Model of an electric bell

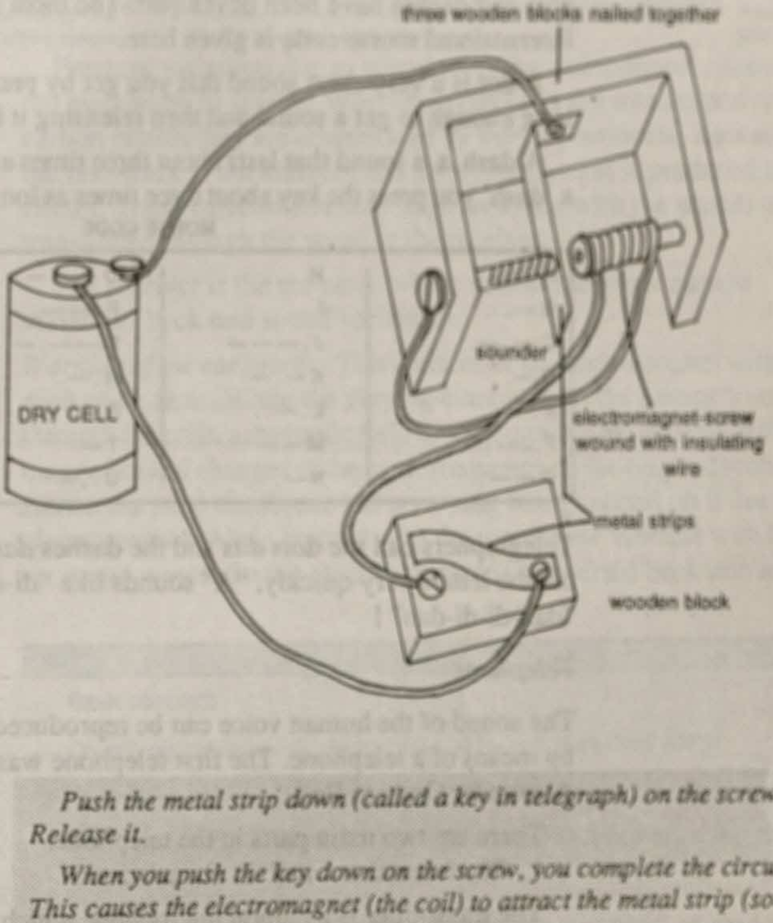
The telegraph

We have seen how electricity is useful in our homes and around it. Electricity is also used for long distance communications. Electricity flowing through wires is used in telegraphs and telephones.

Activity 7 : Make this model telegraph set to understand how the telegraph works.

__Things needed__ : A dry cell, 6-8 metres of thin insulated wire, two iron screws each about 5 cm long (one of them should have a nut), 3 small screws, 4 blocks of wood (each about 6 cm by 6 cm and about 1 cm thick), 2 strips of metal (each about 6 cm long and 1 cm wide) these may be cut from a tin, a few nails.

__Method__ : Connect the equipment as shown in the diagram.


three wooden blocks nailed together
sounder
DRY CELL
electromagnet-screw wound with insulating wire
metal strips
wooden block

Push the metal strip down (called a key in telegraph) on the screw. Release it.

When you push the key down on the screw, you complete the circuit. This causes the electromagnet (the coil) to attract the metal strip (sounder) from the bolt on which it rests.

As soon as the metal strip pulls away from the bolt (screw) below, the circuit is broken. The electromagnet then loses its power and the sounder falls back to the bolt. This makes the circuit complete again and so the electromagnet attracts the sounder. This happens a number of times as long as you press the key down against the screw. The sounder touches the magnet and the bolt, rapidly, one after the other, and a buzzing sound is heard.

If you make the telegraph set with long wires you can keep the key in one room and the rest of the set in another room. You can then send a message from one room to another.

You would have noticed that all the telegraph does is produce buzzing sounds. In order to make communication possible, codes of dots and dashes have been developed. The most popular one, the International morse code is given here.

A dot is a very short sound that you get by pressing the key just long enough to get a sound and then releasing it immediately.

A dash is a sound that lasts about three times as long as a dot. To make a 'dash' you press the key about three times as long as you would for a dot.

MORSE CODE

A .—	H	O ———	V . . . —
B — . . .	I . .	P . — — .	W . — —
C — . — .	J . — — —	Q — — . —	X — . . —
D — . .	K — . —	R . — .	Y — . — —
E .	L . — . .	S . . .	Z — — . .
F . . — .	M — —	T —	
G — — .	N — .	U . . —	

Telegraphers call the dots *dits* and the dashes *dahs*. When they rattle off the letters very quickly, "A" sounds like "di-dah" and "X" like "dah-di-di-dah" !

Telephone

The sound of the human voice can be reproduced over long distances by means of a telephone. The first telephone was invented by Alexander Graham Bell.

There are two main parts in the telephone.

1. The transmitter and 2. the receiver.

The transmitter is a carbon microphone which converts sound variations into varying electric current.

Working of the microphone : Inside the carbon microphone, grains of carbon can be found inside a 'capsule'. One side of the capsule is a thin flexible diaphragm made of aluminium and on the other side is a carbon block.

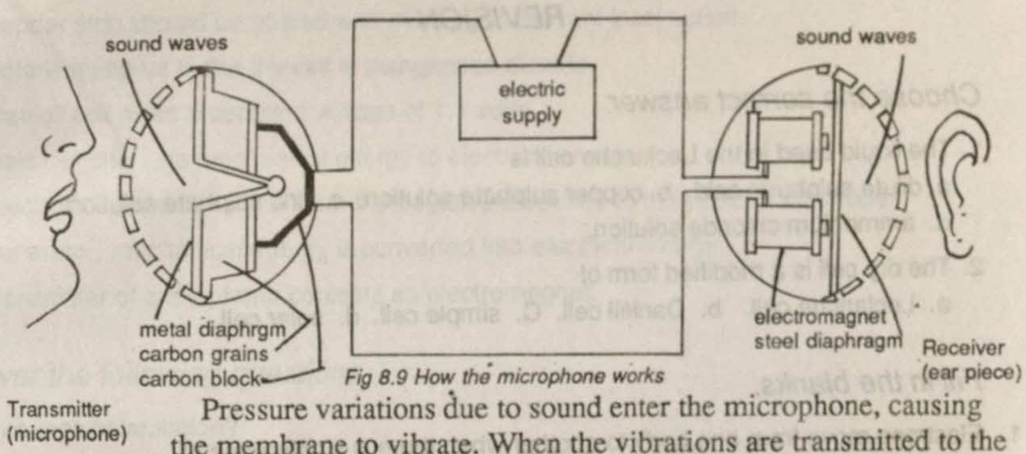


Fig 8.9 How the microphone works

Pressure variations due to sound enter the microphone, causing the membrane to vibrate. When the vibrations are transmitted to the carbon grains, they are compressed by varying amounts. As a result, the resistance is not uniform and a varying current is produced in the circuit. These currents fluctuate in accordance with the sounds and are transmitted through the wires to the receiver.

The receiver is the ear piece which converts electric current variations back into sound variations.

Working of the ear piece : This consists of an electromagnet with coils on each of its arms. When the varying current from the microphone passes through the coils, a magnetic field of varying strength surrounds them. The magnetic field changes at the same frequency as the original sound waves. Hence the steel membrane has a varying force exerted on it due to the electromagnet. Air in contact with the membrane vibrates with it setting up sound waves. So the electric current is converted back into sound.

Basic concepts

1. Dry cell, wet cell, solar cell, generators are all sources of electrical energy.
2. The defects of the simple cell are local action and polarisation.
3. Leclanche and Daniell cells are primary cells in which the defects of a simple cell are removed.
4. A dry cell is a modified Leclanche cell.
5. Solar cells utilize energy from the sun to produce electric current.
6. Oersted showed that when a current flows through a conductor a magnetic field is produced around it.
7. The electric bell, telegraphs, telephones, etc use an electromagnet.

REVISION

I Choose the correct answer.

1. The liquid used in the Leclanche cell is
   a. dilute sulphuric acid. b. copper sulphate solution. c. zinc sulphate solution.
   d. ammonium chloride solution.

2. The dry cell is a modified form of
   a. Leclanche cell. b. Daniell cell. C. simple cell. d. solar cell.

II Fill in the blanks.

1. Electrons move from one body to another when there is a difference of .... between the bodies. The flow of electrons is known as an ....
2. The metal strips in a voltaic cell are called the ....
3. The positive electrode in a dry cell is the............................ .
4. Electric current flows from the............................electrode to the............................electrode.
5. Local action can be prevented by coating the......................... strip with mercury.
6. A negative particle of electricity is known as an...................... .
7. ....is used as a depolariser in the Daniell cell.
8. A wire through which a current flows is surrounded by an ....
9. An electromagnet consists of a............................of wire wound around a core of............................ .
10. When current flows through the wire, the core becomes............................ .
11. The transmitter in a telephone consists of a............................ containing particles of............................ .
12. The current around the north pole of an electromagnet flows in a .... direction.
13. The electric bell works on the principle of the.................... .
14. Morse code is in the form of ....and ....
15. The diaphragm in the receiver of the telephone is made of............................ .
16. Another name for ammonium chloride is............................ .

III State whether true or false.

1. Two similar metals must be used in a cell.
2. The impurities in the zinc strip cause polarisation.
3. The Leclanche cell is used where constant current is not required.

4. The copper strip should be coated with mercury to prevent local action.
5. The polarising agent in the dry cell is manganese dioxide.
6. The Daniell cell gives a constant voltage of 1.1 volts.
7. A Voltaic cell changes mechanical energy to electrical energy.
8. The electrons inside a cell flow from the negative electrode to the positive electrode.
9. In a generator, *mechanical* energy is converted into *electrical* energy.
10. The transmitter of a telephone contains an electromagnet.

IV *Answer the following questions*

1. What causes polarisation?
2. What is local action? How is it prevented?
3. Draw a neatly labelled diagram of a Daniell cell and explain its working.
4. Draw a neatly labelled diagram of a Leclanche cell and explain its working.
5. What are electromagnets? List some of their uses.
6. Describe the working of the telegraph.
7. What happens in an electric bell when the current is switched off?
8. How does the electromagnet resemble a bar magnet?
9. Draw a neat diagram of an electric bell.
10. Draw neat diagrams of the telephone transmitter and receiver and explain their working.

V *Match the following*

1.	(i) simple cell	a. Daniel cell
	(ii) local action	b. battery
	(iii) polarisation	c. Leclanche cell
	(iv) copper sulphate solution	d. hydrogen bubbles
	(v) manganese dioxide	e. volta
	(vi) ammonium chloride	f. zinc rod
		g. depolariser

2.	(i) transmitter	a. hammer and gong
	(ii) receiver	b. carbon grains
	(iii) telegraph	c. zinc rod
		d. steel diaphragm
		e. sounder.

TEST PAPER I

Time : 1 1/4 hours

I. *Choose the correct answer.* 1 x 4 = 4

1. One litre is equivalent to
   - a. 500 cc.
   - b. 100 cc.
   - c. 1000 cc.
   - d. none of the above.
2. Gear wheels are a form of the
   - a. pulley.
   - b. wheel and axle.
   - c. inclined plane.
   - d. screw.
3. An aneroid barometer contains
   - a. mercury.
   - b. water.
   - c. no liquid.
4. Mercury is used in thermometers because it
   - a. is red.
   - b. is heavy.
   - c. expands more than glass.
   - d.. does not wet glass.

I. *State whether true or false.*

1. The volume of a lead shot can be found using a pipette.
2. The stability of a body depends on the position of its centre of gravity.
3. The height of the barometer does not change if the tube is tilted.
4. The freezing point of mercury is —39°C.

III. *Fill in the blanks.*

1. The unit of weight is ....
2. Sliding friction is more than .... friction.
3. The height of the mercury barometer is .... cm of mercury at sea level.
4. A .... surface is a good absorber of heat.

IV. *Match the following :*

1. Altimeter	a. convection
2. Davy's safety lamp	b. lubrication
3. Friction	c. radiation
	d. height
	e. conduction

V. *Answer any five questions :*

1. How will you find the area of a leaf using a graph paper ?
2. Describe the pipette. How will you use it to measure out a given quantity of liquid?
3. What is friction ? When is it unwanted ? How can we reduce the friction between the moving parts of a machine?
4. How will you determine the centre of gravity of an irregular lamina?
5. How will you demonstrate that air exerts pressure?
6. How will you construct a cistern barometer?
7. How will you show that water is a poor conductor of heat?
8. How will you show that the boiling point of a liquid reduces with pressure?

VI. *Answer any one question :*

1. How will you determine the volume of a lead shot using a burette?
2. Draw a neat diagram of a lift pump and explain its working.
3. Describe a thermos flask with a neat diagram. How does it keep things hot or cold?

TEST PAPER II

Time : 1 $^1/_4$ hours

. *Choose the correct answer.*

1. The boiling point of water is raised by
   a. increasing the pressure above it.
   b. decreasing the pressure above it.
   c. taking it to a higher altitude.
   d. increasing the temperature.
2. A decibel is
   a. a musical instrument.
   b. an instrument for determining pitch.
   c. a unit of loudness.
   d. a unit of tone.
3. Non-luminous objects are visible to our eye because
   a. our eye emits light.
   b. the objects reflect light.
   c. the objects are transparent.
   d. the objects absorb light.
4. A magnet gets demagnetised if you
   a. suspend it freely.
   b. keep it on ice.
   c. store it with keepers.
   d. heat it.

II. *State whether true or false.*

1 x 4 = 4

1. A screw is an example of an inclined plane.
2. A bottle lying on its side is in stable equilibrium.
3. Water is a good conductor of heat.
4. An aluminium diaphragm is used in telephone receivers.

III. *Fill in the blanks.*

1 x 4 = 4

1. The system of units we use is called the.. system of **units.**
2. The layer of the atmosphere in which the temperature remains constant is **called** the...................... .
3. Air is a.......................... conductor of heat.
4. The real organ of hearing is called the ....

IV. *Match the following :*

1. steel index
2. steel diaphragm
3. steel bar

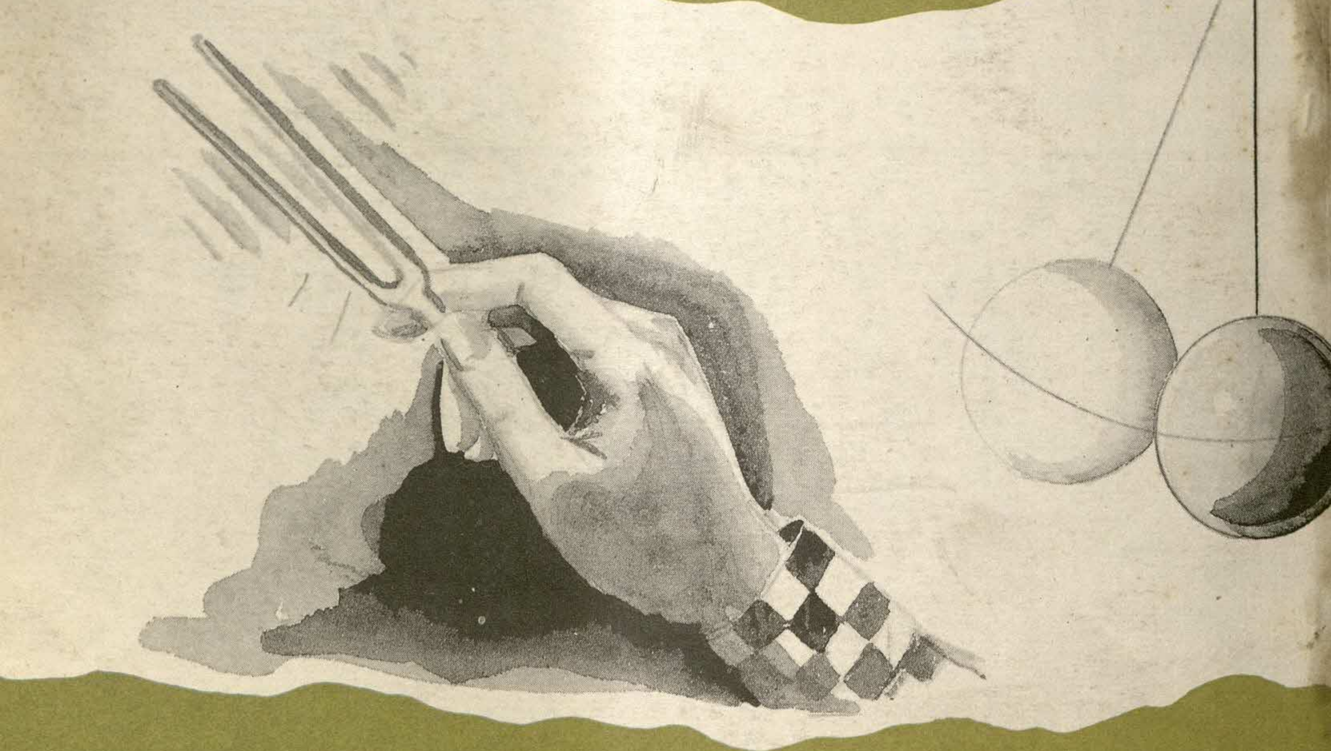
a. temporary magnets
b. permanent magnets
c. maximum thermometer
d. telephone receiver

V. *Answer any five questions.*

1. How will you find the area of a leaf using a graph paper?
2. What is friction? How can it be reduced?
3. Write a short note on the troposphere.
4. Describe the clinical thermometer.
5. Draw diagrams explaining the umbra and penumbra.
6. Describe an experiment to show that a medium is necessary for the propagation of sound.
7. Repulsion is the surest test of magnetism. Explain.
8. Draw a neatly labelled diagram of the electric bell.

VI. *Answer any one question.*

1. Explain the construction and working of a force pump.
2. Describe the vacuum flask and explain how it keeps food hot or cold.
3. Draw neat diagrams to explain the action of a telephone transmitter and receiver.



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